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THE TREES OF THE BOTTOMLANDS
OF THE MISSISSIPPI RIVER DELTA REGION

Their distribution, occurrence by site and cover type,
utilization in the Delta, and the distinguishing characteristics
of the principal and most common species
and groups of species.

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This paper releases data gathered in current investigations at the Southern Forest Experiment Station, and is subject to correction or modification following further investigation.

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Introduction

The bottomlands of the lower Mississippi River valley, or Delta, extend from about Cape Girardeau, Missouri to the Gulf of Mexico, in a north-and-south belt varying from about 30 to 115 miles in width, and cover some 29,000,000 acres^{1/}. Agriculture (principally the growing of cotton) is well developed but strongly localized and more or less confined to the better soils along the larger rivers and bayous, and the Delta is still a very important forest region. It is often referred to as the bottomland hardwood region and it produces the bulk of the finest hardwood timber cut in this country. Cypress, the only important conifer, is also produced in great volume.

The Delta has long been noted for the quantity and quality of its timber, yet was practically a virgin field to professional foresters until 1928. In the following pages, an attempt is made to summarize briefly the information thus far collected by the Southern Forest Experiment Station concerning the numerous tree species found in the region. J. A. Putnam started this work in 1929 with a manuscript which has served as the foundation of the present report. The sections on utilization, manufacture and economic considerations are entirely his work and have been taken from his original manuscript after making some minor changes. The help and cooperation of several members of the Station staff, especially G. H. Lentz and R. K. Winters, is acknowledged with gratitude.

This report is designed to be useful particularly to two groups, (1) foresters beginning work in the Delta, and (2) students of forestry. Both groups are presumed to be well grounded in dendrology and complete, detailed descriptions of each species are therefore omitted. These can be found in the various standard

^{1/} Lennett, H. H. The Soils and Agriculture of the Southern States, p. 314. The Macmillan Company, 1921.

dendrology texts (of which a short bibliography is given on page 202). Distinguishing characteristics are given, however, wherever it is necessary or helpful in separating somewhat similar species.

Each group is presumably unfamiliar with the topographic characteristics of the Delta region, hence a classification of forest sites is presented and the nature of each site described. Maps of the Delta regions of Louisiana, Mississippi, Arkansas and Missouri are also presented, accompanied by a brief explanatory section. They should prove exceedingly useful.

To understand the distribution and associations of the different species a knowledge of the forest cover types is practically essential and a list and description of tentative types is accordingly given.

The section on the utilization and manufacture of hardwoods in general will be found very helpful to a better understanding of the notes on the utilization of each species. From a forester's viewpoint, utilization is of basic importance.

In the tabular outline (p. 16 et seq.), an attempt has been made to list all species at present known definitely to occur in the Delta bottomlands. Several rather obscure and relatively unimportant varieties of these species are, however, omitted, and several uncommon species have undoubtedly been overlooked, so that the outline is in no sense to be taken as a complete check list. The more important and the more common and widely distributed species are described in considerable detail in the last section (p. 65 et seq.).

It should be clearly understood that all information given in the following pages was collected entirely within the Delta bottomlands and applies specifically and only to the Delta bottomlands. In some cases the information may apply equally well to other southern bottomlands or even to certain uplands but such extensions have yet to be worked out in detail and none are even implied.

in the following notes and descriptions. The observations on which this report is based were made principally in Louisiana, next most abundantly in Arkansas, and the fewest observations were made in Mississippi and Missouri. The relative applicability of this report to the different states can be judged accordingly.

This is in no sense the final word on the subject and future amendments and additions will undoubtedly be necessary; it merely reports our present knowledge, and after the fashion of the note always appended to the description in financial advertisements of the properties, value, earnings, etc. of companies offering stocks or bonds for sale, it may be said that "the information given is obtained from reliable sources and is believed to be accurate but is not guaranteed".

CLASSIFICATION OF FOREST SITES IN THE DELTA

The Delta comprises the present and former flood-plains of the Mississippi River and the lower portions of a number of tributaries. The principal sites may be classified and described as follows:

I. First bottoms.

1. Ridges.

a. River margins.

2. Flats.

3. Washboardy or hummocky sites (including sites of indeterminate or mixed character).

4. Swamps.

II. Second bottoms or terraces.

1. Ridges.

2. Flats.

3. Washboardy or hummocky sites (including sites of indeterminate or mixed character).

4. Swamps.

III. Minor sites and topographic features (occurring in both first and second bottoms).

1. Swags.

2. Drains or shallow sloughs.

3. Gullies.

I. First bottoms.*

First bottoms are the lowest-lying and most recently-formed areas of alluvial soil and are usually still subject to overflow. Drainage ditches

*First two paragraphs taken largely from H. H. Bennett, The Soils and Agriculture of the Southern States, Macmillan Company, 1921, pp. 276 et seq.).

and levees may now, however, prevent overflow on these areas except in times of unusually high flood waters.

In first bottoms there has been little opportunity for weathering and alteration of the soil texture, due to their youth and to the more or less continual deposit of fresh material. Oxidation is retarded by the nearly continuous presence of an excess of moisture, producing grayish, mottled, pale-yellow and rusty-brown colors (in contrast to reddish, brownish and deep yellow colors of most well-drained, well-oxidized soils). In the Delta, the first bottom soils are generally clays or silty clays but occasionally, on the more extensive frontlands, sands (usually very fine sands) occur.

1. Ridges are slight to moderate elevations (a few inches to several feet above the prevailing ground level) that are the remnants of old stream banks. The soil may or may not be lighter in texture than on the adjacent flats but it is always very much better drained. The soil is generally clay or silty clay but in one or more horizons is often much sandier or more silty than on the flats. The ridges are the last parts of the bottoms to be submerged during floods and frequently they are never submerged at all except during exceptional floods, as in 1927. They are generally long, more or less curving or serpentine, and roughly parallel to existing water courses--sloughs, bayous and rivers. The present banks of all existing water courses are of course also ridges and are known as "frontlands". Frontlands, where extensive and fronting important, well-developed drainages, are the principal sites for agriculture. The term "ridge" also includes the slope away from the frontland as far as the drainage is affected. This slope may extend 2 or 3 miles back from the highest part of the ridge in the case of the Mississippi River frontlands but does

not usually extend more than a few hundred yards at most in the case of the interior ridges.

1-a. River margins. These include the immediate margins or banks of the larger rivers and streams having a definite current (as distinct from bayous with little or no current), the sand or clay bars and the banks of the cut-offs in use by those rivers. The soil consists either of alternate strata of sand and clay, of which the sand (very fine sand to coarse sand) is usually the more important, or, more commonly, of deep deposits of sand (usually very fine sand). River margins include the portions of frontlands that face the larger, active streams and are generally subject to overflow at every considerable rise in the river, since by their nature they are not and can not be protected by levees, but the highest river margins of such rivers as the Mississippi are above all but exceptional overflow, as in 1927. All land between a river and its levee is called batture land. The batture lands of the Mississippi are generally from one-quarter mile to four miles wide.

2. Flats. These comprise the low, flat portions of the flood plains that lie between the ridges and are the predominant site of the first bottoms. The soil is probably invariably clay or at best silty clay and varies from extremely tight, sticky, impervious clay to moderately pervious silty clay. The latter is usually underlain by one or more strata of fine sand. Certain flats are subject to direct overflow to a depth of from one to ten feet from backwater from the principal streams in the spring where unprotected by levees. On all flats, winter rains usually accumulate to a depth of from a few inches to a foot or more, often for long periods, between November and March, but from midsummer to early fall the flats are generally very dry.

3. Washboardy or hummocky sites. These are made up of successive

ridges and flats, each too narrow, too irregular and in too small unit areas to be considered a separate site. The distance between the ridge crests and the flat troughs usually varies from 5 or 10 feet to 100 or 150 feet, and the corresponding difference in elevation is usually from a few inches to two feet or more. Instead of definite ridges, however, the higher parts of this site are often irregular isolated mounds or hummocks. The soil in both the ridge and flat parts is usually of the type found on ridges, but the flat parts are of course much more poorly drained than the ridge parts. The site as a whole is usually very wet and mushy during the winter. Sites of indeterminate or mixed character, i.e., with characteristics of both ridge and flat yet not apparently either definitely washboardy or hummocky, are also included here.

4. Swamps are generally basin-like depressions, usually enclosed by ridges, in which rain water stands to a depth of from two to six feet between late fall and early summer (and in which a depth of twenty feet or more may be reached when flooded by backwater). During the summer and early fall the majority of swamps become practically dry and even the deepest swamps will dry out during exceptional drought years such as 1924. Swamps also include deep sloughs, which are abandoned bayou courses.

II. Second bottoms or terraces.*

Second bottoms (including terraces, benches, etc.) are old flood plains now standing above the influence of stream water (except occasionally during severe floods). Their average elevation is distinctly greater than that of first bottoms.

In second bottoms, due to their greater age, usually better drainage

*First two paragraphs taken largely from H. H. Bennett, The Soils and Agriculture of the Southern States, Macmillan Company, 1921, pp. 273 et seq.).

conditions, and freedom from overflow and additional deposition, chemical changes and alteration by erosional and percolating waters have resulted in producing many characteristics common to upland soils. One can not assume, however, that such old alluvial soils are the same as the nearby upland soils that they may closely resemble, especially where the drainage waters of the streams flow in part from regions having different upland soils. Even though the physical features are apparently identical, the chemical and mineralogical characteristics of such alluvium and nearby upland soils may be very different. The second bottom soils are principally silty clay loams, silt loams, fine sandy loams and very fine sandy loams. The silt and fine sand fractions are most important and clay is of distinctly secondary importance.

1. Ridges have essentially the same origin as ridges in the first bottoms, but due to their greater and more variable age and the consequent variably longer operation of modifying agencies, they are not so uniform. Some are very flat-surfaced and extensive (e.g., in east central Arkansas) and others have an irregular, somewhat rolling, more dissected surface. Some very high "second" bottoms are properly third or fourth (or even higher) bottoms, e.g., Macon Ridge in northeastern Louisiana. For convenience these high terraces are designated as "second or higher bottoms" in referring to them as a habitat of various tree species. Ridges are the prevailing elevations and the predominant site in second bottoms just as flats are the predominant site in first bottoms. The soils are largely if not entirely loams (silty clay loams, clay loams, fine sandy loams, very fine sandy loams, etc.) and they are moderately well to very well drained.

2. Flats are the areas between the ridges. The soils are of essentially the same texture as on the adjacent ridges and the principal difference is therefore due to difference in elevation. The flats are poorly or very poorly drained and the soils are grayer and more mottled than on the

ridges, due to their poorer oxidation and frequent water-logged condition.

The sub-soil is generally very impervious and frequently approaches a hardpan. Winter rains usually accumulate in pools or shoots just as in first bottom flats.

3. Washboardy or hummocky sites are of the same nature as in first bottoms but the higher parts are probably more apt to be definite ridges than irregular hummocks and the soils are less mushy and more similar to those of adjacent ridges and flats. Sites of indeterminate or mixed character, i.e., with characteristics of both ridge and flat yet not apparently either definitely washboardy or hummocky, are also included here.

4. Swamps are depressions in which water usually stands from one to four feet deep during the winter months but which generally are practically dry in late summer and fall.

III. Minor sites and topographic features (occurring in both first and second bottoms)

1. Swags are small local pockets or depressions and usually occur on ridges. They quickly accumulate water from heavy rains and as quickly dry out during fair weather. They are important principally because they frequently account for the presence on rather well-drained sites of trees typically found only on poorly-drained sites.

2. Drains or shallow sloughs are old, well-filled-in bayou beds that have the appearance of narrow, elongated flats and the site characteristics of flats. They are usually distinguished on ridge lands.

3. Gullies are tributaries, most common in first bottoms, that connect flats with the smaller bayous. They traverse ridge lands and have a V-shaped profile (very disconcerting to those who have to wade across them). They vary from two to twenty or thirty feet in depth depending on their age, the width of the ridge land traversed and the elevation of the bayou front.

Except when the bayou is high and backs up in the gully, the latter usually has a good current. Gullies are essentially young ~~streams or~~ bayous. They are usually dry in midsummer and early fall.

THE DELTA REGIONS OF LOUISIANA, MISSISSIPPI, ARKANSAS
AND MISSOURI

The Delta regions of Louisiana, Mississippi, Arkansas and Missouri and their approximate division into first bottoms, second bottoms or terraces and loessial uplands or very high terraces, are shown on outline maps, Figures 1-4. These principal geologic subdivisions are essentially primary forest sites and therefore strongly correlated with forest cover types or associations and the distribution of individual species. The divisions on the maps are necessarily diagrammatic and do not pretend to be technically accurate in detail from the viewpoint of a geologist or soil scientist. Prepared by J. A. Putnam, they are based not only on careful examination of all available geologic and soil maps of the regions but also on his wide personal knowledge of the greater portion of the area. The maps therefore give a sufficiently accurate general picture to be extremely useful adjuncts to the discussions of the distribution and occurrence of forest types and species. The actual forest conditions prevailing over the areas shown on the maps agree as closely and consistently as possible with the relations between the forest cover and the principal geologic subdivisions or primary forest sites indicated in the text.

For a precise dendrological or ecological study, many of the smaller subdivisions would necessarily have to be rechecked. In any case, a study of larger and more detailed maps to supplement the small diagrammatic maps and the site descriptions is advisable in order to grasp the full significance of the subject.

Without the expert advice of a geologist or soil scientist familiar with the Delta, the technically correct separation of first bottoms from

second bottoms is impossible in certain localities, e.g., at the western margin of the Delta in extreme southern Louisiana and in the northern part of the Delta in Mississippi. The subdivisions are necessarily rather arbitrary in such cases. The distinction between very high terraces (or third or higher bottoms) and true loessial uplands is also uncertain and all areas definitely higher than second bottoms are accordingly arbitrarily grouped together on the maps. The forest cover of the two classes of land is very similar and from that point of view it makes little difference to which class any specific area belongs. The narrow belt of "loessial upland or high terrace" in northern Louisiana (Macon Ridge) is actually entirely high terrace (third and/or higher bottom). Recognition of such "upland" areas is necessary because many of them form prominent "islands" within the Delta region of Louisiana, Arkansas and Missouri and because those that are situated at the margin have at least as much in common with the Delta as with the adjacent pine uplands. They support a distinctive, high-grade hardwood forest cover, whereas the Delta is otherwise bounded by pine or at best pine-hardwood uplands of a much different nature (except in southern Louisiana where it is bounded by prairie and marsh). The comparatively wide belt of loessial upland indicated on the eastern border of the Delta in central Louisiana and in Mississippi is not a part of the Delta. It is shown because it is forested with hardwoods and because both the soil and forest cover are similar to that found on many "islands" in the Delta.

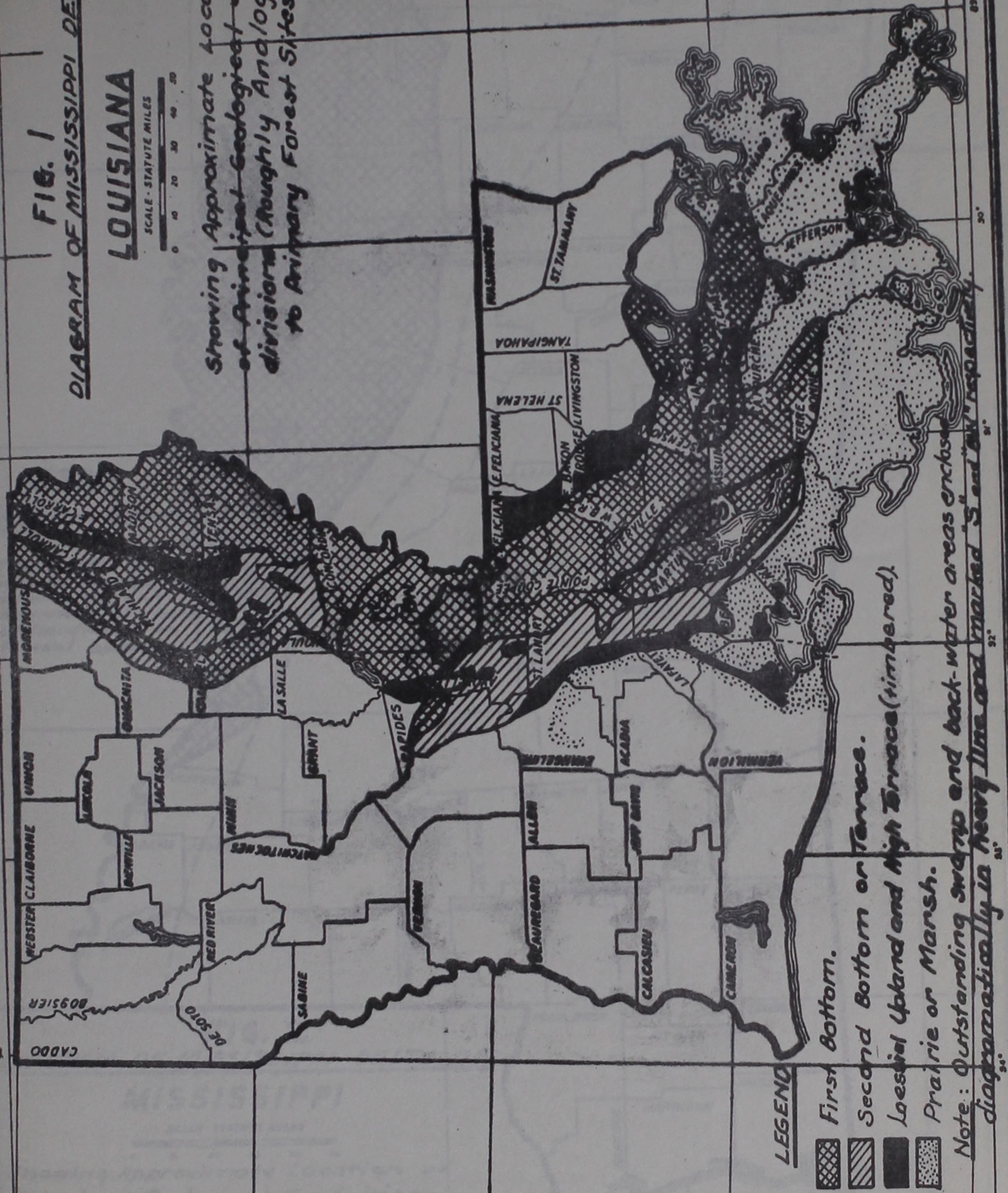
On the map of Arkansas, the heavy solid line drawn to the southwestern corner of the state is the approximate northern boundary of an upland pine region in which the Delta type of bottomland is unusually important, due principally to the inclusion of the Ouachita and Saline Rivers and their larger tributaries and somewhat less to the inclusion of the Red

FIG. 1
DIAGRAM OF MISSISSIPPI DELTA OF

LOUISIANA

SCALE - STATUTE MILES
0 10 20 30 40 50

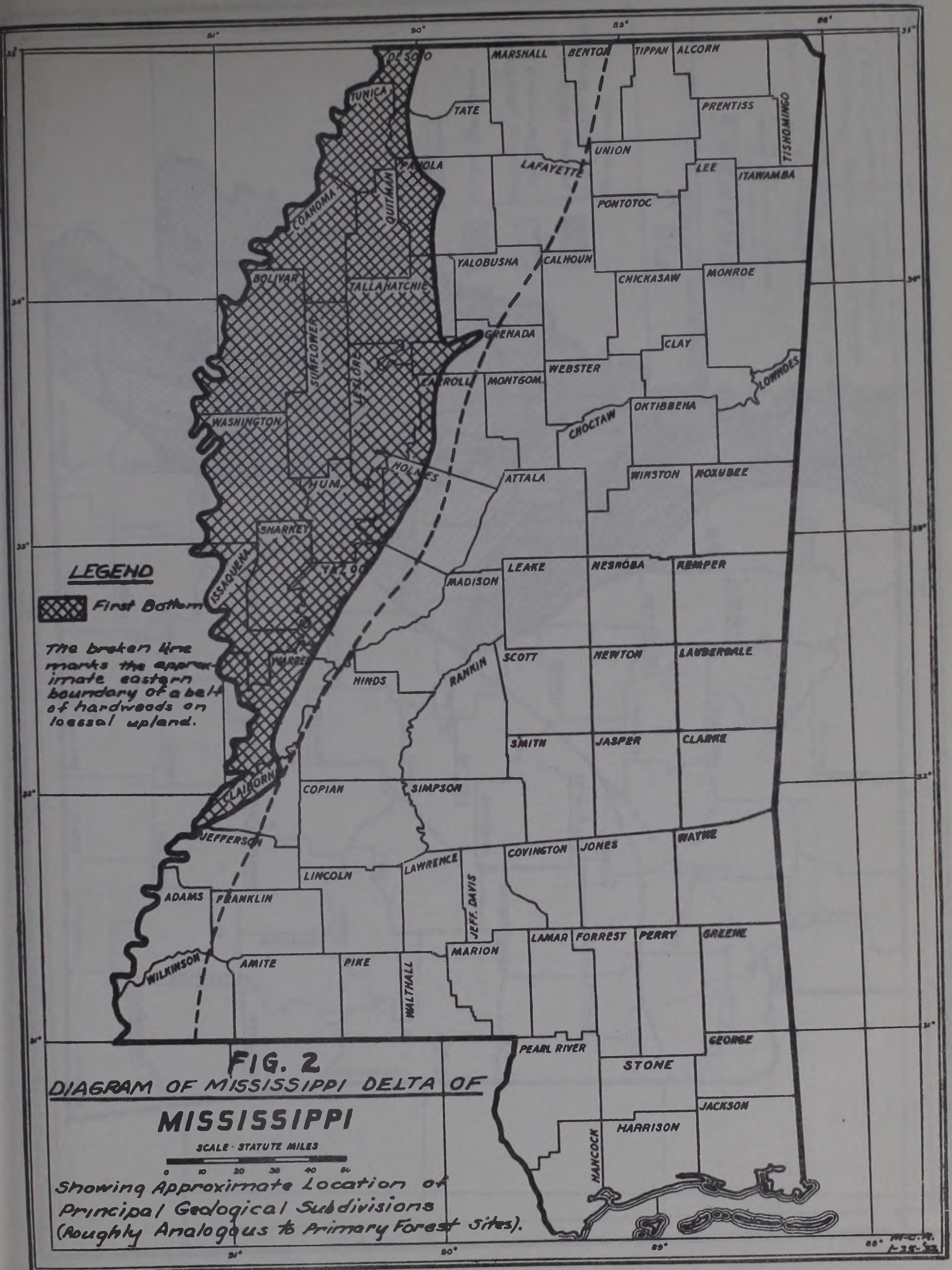
*Showing Approximate Location
of Principal Geological Sub-
divisions (Roughly Analogous
to Primary Forest Sites).*



LEGEND

- First Bottom.
- Second Bottom or Terrace.
- Loessial Upland and High Terrace (timbered).
- Prairie or Marsh.

Note: Outstanding swamp and back-water areas enclosed diagrammatically in heavy line and marked "S" and "M" respectively.



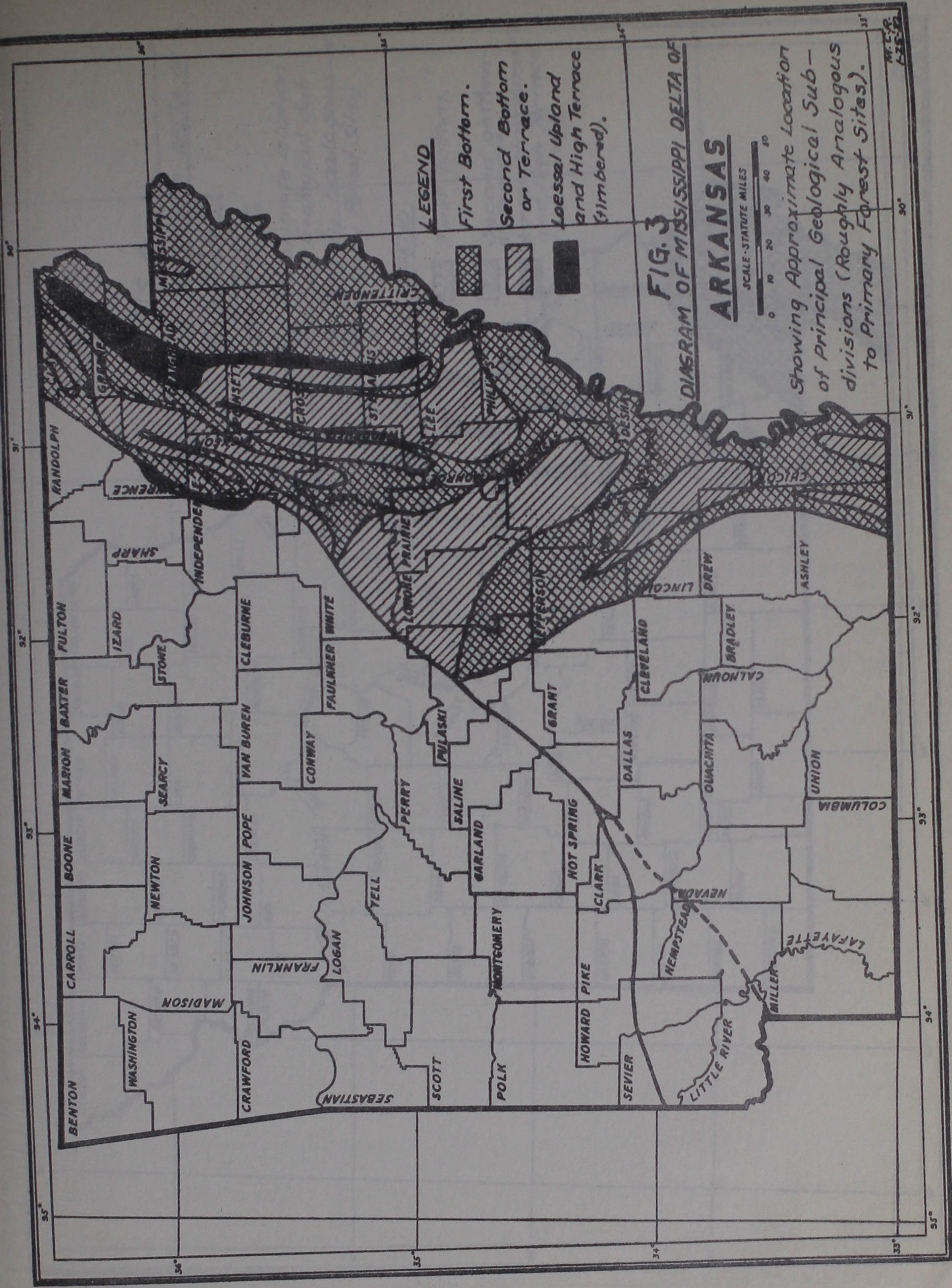


FIG. 3
DIAGRAM OF MISSISSIPPI DELTA OF

ARKANSAS

SCALE - STATUTE MILES

0 10 20 30 40 50

Showing Approximate Location
of Principal Geological Sub-
divisions (Roughly Analogous
to Primary Forest Sites).

FIG. 4

DIAGRAM OF MISSISSIPPI DELTA OF
MISSOURI

SCALE-STATUTE MILES
0 10 20 30 40 50

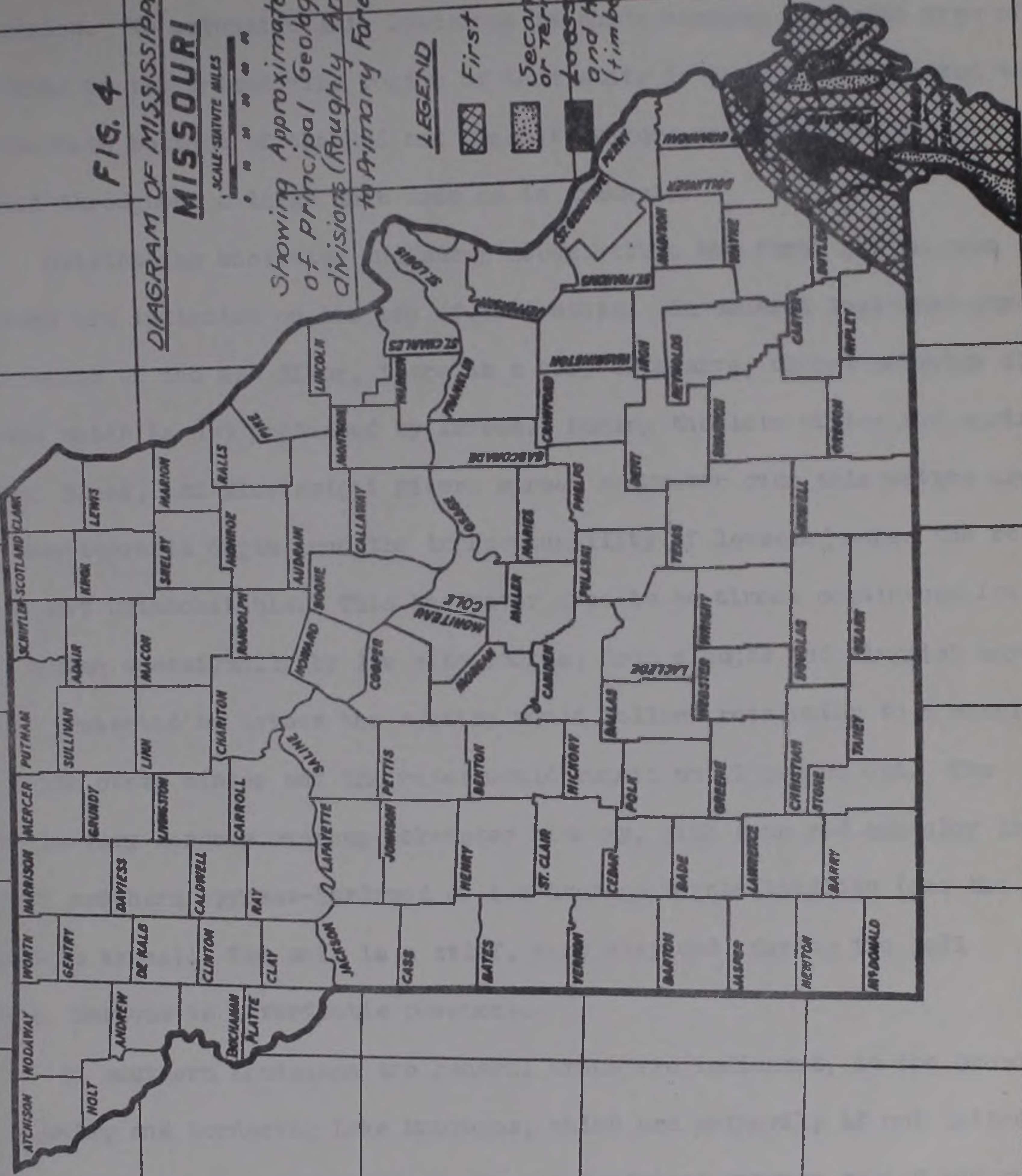
Showing Approximate location
of Principal Geological Sub-
divisions (Roughly Analogous
to Primary Forest Sites)

LEGEND

First bottom.

Second bottom
or terrace.

Loessial upland
and High Terrace
(timbered).



River. In fact, the Delta region might very well be shown extended to a considerable distance along these large rivers. The area north of the broken line on the map is probably but not certainly a logical part of this upland pine region. No extension into Louisiana is shown because the Delta type of bottomland in the upland pine region of that state is essentially limited to the immediate bottoms of the Red and Ouachita Rivers and is not well distributed throughout a large unit area as in Arkansas.

Outstanding backwater and swamp areas within the first bottom area of Louisiana are indicated on the map of that state. In central Louisiana north of the mouth of the Red River, there is a very extensive, almost unbroken flat or basin which is not protected by levees. During the late winter and spring the Red, Black, and Mississippi Rivers spread backwater over this entire area to a considerable depth, and the impracticability of leveeing makes the region almost uninhabitable. This backwater area is an almost continuous low flat, broken occasionally by low clay ridges, deep sloughs and sluggish bayous. Even if protected by levees the country would collect rain water to a considerable depth every winter and the water would remain until pumped out. The timber is very largely overcup oak-water hickory, with some red gum-clay land oaks and southern cypress-hardwood of low average merchantability (see the section on types). The soil is a stiff, waxy clay and, during the fall drought, hardens to a veritable pavement.

In southern Louisiana two general areas are indicated, in the Grand Lake country and bordering Lake Maurepas, which are primarily if not entirely swamp. They represent the heart of the old Louisiana cypress region and until comparatively recently were the principal source of supply of the cypress industry which is now centered in Florida. These areas, particularly in the Grand Lake country, comprise a network of sloughs and sluggish bayous between

which are low flats and swamps broken occasionally by insignificant low ridges, especially at the slough and stream banks. All of the sloughs and swamps are full of water or at least wet from late fall through early summer, and during the spring rise of the Mississippi and Atchafalaya Rivers the entire area with the exception of the most pronounced ridges is inundated. By October, however, most of the area is dry and in average years the region can be traversed on foot during the late summer and early fall.

The Maurepas Swamp is closer to tidewater and has never been so directly affected by the Mississippi River; it is largely a local feature and consequently has neither the variation in water level nor the topographic relief of the Grand Lake country. The soils are also somewhat different; muck is much more prevalent than clay.

The remaining timber in both of these swamp districts is largely tupelo gum, which constitutes an immense resource. In the Maurepas area much of the so-called "tupelo" or "gum" is Swamp Black Gum, Nyssa biflora Walter, rather than true Tupelo Gum, Nyssa aquatica L. This is probably the only locality in the Delta where swamp black gum is found.

The swamp country is entirely uninhabited insofar as permanent habitation is concerned but large numbers of French and "Cajun" fishers and trappers make their living there and maintain small cabins, houseboats and the like.

Regarding the remainder of the Delta not especially designated as "swamp" or "backwater", and excepting the local sloughs and swamps and possible backwater areas at the mouths of several other principal rivers, it must be stated emphatically that the Delta is not a swamp and does not at all resemble one. This statement is made advisedly to clear up a common impression of the Southern Bottomland Hardwood Region held by people unfamiliar

with it. With the above exceptions, it is about 50 per cent improved land, much of it by far the best in the South, and it contains relatively as many well-developed communities, towns and transportation systems as the South in general. In spite of the fact that but for the protection afforded by the levees two-thirds to four-fifths of it would be subject to temporary annual or periodic overflow, it is probably no more chronically wet and swampy than the Gulf Coastal Plain in general (although it is muddier when wet due to the vast difference in soil). Even in the days of slavery, before the development of the levee system, the Delta was extensively settled and already well on its way toward becoming the cotton center of the South.

TABULAR OUTLINE OF TREE SPECIES FOUND IN THE BOTTOMLANDS OF THE MISSISSIPPI RIVER DELTA REGION

Species ^a		Geographic Range in the Delta ^c	Distribution and Habitat in the Delta Bottomlands	Occurrence by Forest Types ^d	Principal Commercial Uses
Common Name	Im- port- ance ^b Scientific Name				
Loblolly pine	4 <u>Pinus taeda</u> L.	Probably throughout the Delta (except possibly from northern Ark. north.	Confined entirely to ridges and washboardy or hummocky sites in second or higher bottoms (high terraces).	2.	Lumber and structural material.
Southern cypress	1 <u>Taxodium distichum</u> (L.) Richard	Abundant to predominant in southern Louisiana. Northward, more or less local but occurs throughout the Delta.	The commonest species of the low flats and swamps of southern Louisiana. Northward, confined principally to bayou banks, sloughs, swags and swamps but often common mixed with hardwoods on flats.	14, 11, 15. (Also in other types, but confined to such small local sites as swags and the banks of bayous, gullies, etc.)	Lumber for tank and ship stock, etc. (both factory and structural uses). Piling, shingles, etc.
Black walnut	5 <u>Juglans nigra</u> L.	Only in the northern third of the Delta, from east central Arkansas northward.	Probably confined to loamy ridges in second or higher bottoms.	1, 4.	Lumber for interior finish, cabinet work, etc. (Very valuable, but of only minor importance in the Delta because so uncommon.)
Pecan (sweet pecan)	5 <u>Hicoria pecan</u> (Marshall) Britton	Throughout the Delta, but principally in first bottoms.	Most common on ridges (especially front ridges) in first bottoms and rather uncommon in second bottoms. Not common anywhere on flats.	4, 5, 3, 10, 9. 8. (Sel- don makes up more than a very small percentage of the stand.)	Used less for typical hickory products than for auto body work. Some use in furniture as walnut substitute and for baseball bats. Scantily utilized and not preferred.

Water hickory (in the Delta almost invariably called bitter pecan).	5	<u>Hicoria aquatica</u> (Michaux f.) Britton	Throughout the Delta but principally in first bottoms.	Usually very common on low, wet, tight clay flats in first bottoms. Much less common on low second bottom flats. Rare everywhere on ridges except bayou or gully banks frequently and deeply flooded, and except in local swags and drains.	13, 10, 8, 9, 11.	Lumber, for about the same purposes as pecan (directly above). It is usually poorer than pecan, however, is even more scantily utilized and is often of too poor quality to cut at all. The heart is very shaky.
Bitternut hickory)	<u>Hicoria cordiformis</u> (Wang.) Britt.	With the exception of the two listed directly above, the species of <u>Hicoria</u> found in the Delta bottomlands are difficult to distinguish but apparently include at least the six named. At present, nothing definite can be said of any of these species. These hickories, as a group, range throughout the Delta but are especially common in Arkansas, where they occur on both flats and ridges, chiefly in second bottoms. They are widely distributed but only locally common. The six listed (especially the last four) and probably additional unlisted species, since they are especially common in second bottoms or terraces, are conveniently designated by the term "terrace hickories".		1, 4, 2, 7.	Thick lumber and dimension stock for vehicle, spools and handle stock
Nutmeg hickory	)	<u>H. myristicaeformis</u> (Mich. f.) Britt.			
Shagbark hickory	)	<u>H. ovata</u> (Miller) Britt.			
Bigleaf shagbark hickory	)	<u>H. laciniosa</u> (Mich. f.) Sarg.			
Mockernut hickory	)	<u>H. alba</u> (L.) Britt.			
Pignut hickory	)	<u>H. leiodermis</u> (Sarg.) Sudworth			
)					
)					

Wax-myrtle (bayberry)	6	<u>Myrica cerifera</u> L.	Probably restricted in the Delta to southern and southeastern Louisiana, in the neighborhood of the Gulf Coast and near Lakes Maurepas and Pontchartrain.	On bayou banks, ridges and the edges of swamps along the Gulf Coast. In swamps near Lakes Maurepas and Pontchartrain.	16, 14, 15 (Occasional to abundant in the intermediate cover as a shrub to small tree.	Never cut.
Swamp cottonwood	5	<u>Populus heterophylla</u> L.	Probably throughout the Delta.	Confined to shallow swamps and sloughs, but very local in occurrence even in these sites.	14, 12 (only in swamps and sloughs), 15, 13.	Rarely cut, but probably used for the same purposes as cottonwood (directly below).
Cottonwood (Southern cottonwood in Sudworth)	2	<u>Populus deltoides virginiana</u> (Castig.) Sudworth	Throughout the Delta.	Confined very largely to river margins and batture land (where it is very common or predominant on the higher, sandier sites), old fields and the banks of drainage ditches. Occasional on interior, usually sandy or loamy ridges in openings.	3, 5, 12, 4, 11.	Lumber for wagon-box boards, crating, furniture (veneer backing), novelty stock, etc. Pulp. Slack cooperage.
Black willow and others	5	<u>Salix nigra</u> Marshall and variety <u>altissima</u> Sargent and <u>Salix</u> sp.	Throughout the Delta.	Most common, and usually predominant, on the lower, wetter and less sandy sites on river margins and batture land. Also common in swamps, sloughs and swags and on the banks of bayous, gullies and drainage ditches. Rare elsewhere.	12, 14, 15, 3.	Lumber, largely for boxes and crating.
Blue beech	6	<u>Carpinus caroliniana</u> Walter	Probably throughout the Delta.	Confined to the higher loamy ridges in both first and second bottoms.	1, 4, 5, 2. (Usually only an understory species.)	Rarely cut (except for fuel) because of small size and poor form and quality.
River birch	5	<u>Betula nigra</u> L.	In the Delta, probably confined to the northern half.	Not common anywhere in the Delta. Confined to river margins and local depressions containing fresh silty or sandy alluvium.	12, 11 (rarely and locally).	Lumber for cheap furniture, boxes and crates. (But rarely cut at all in the Delta.)

RED OR BLACK OAKS Pin oak	4	<u>Quercus palustris</u> Muench.	The northern half of the Delta, from southern Arkansas northward. Probably not present at all in Louisiana. Probably throughout the Delta but apparently not common anywhere.	Largely restricted to flats in both first and second bottoms but also found on low clay or loamy ridges. Often locally very common.	9, 11, 10, 8, 13, 7, 6.	Lumber and ties.
Shumard red oak	4	<u>Quercus shumardii</u> Buckley		Largely confined to washboardy or hummocky sites in either first or second bottoms. Occasional on rich loamy flats in second bottoms or on ridges near water courses.	7, 1, 4.	Lumber and ties.
Nuttall oak	1	<u>Quercus nuttallii</u> Paine (not described until 1927).	Throughout the Delta and frequently very common.	Occasional to very common on all flats in both first and second bottoms (especially the former) and on clay ridges in first bottoms. Common in swags and drains. Rare on loamy ridges.	2, 6, 10, 8, 5, 11, 13, 7.	Lumber and tight cooperage.
Black oak	5	<u>Quercus velutina</u> Lamarck	Probably throughout the Delta region but very uncommon in the bottomlands proper. (Possibly only in Arkansas and Missouri.)	Confined to the higher, loamy ridges in second or higher bottoms. (A common upland species)	1, 4, 2.	Lumber and ties. (Wood of good quality but of minor importance because so rare.)
Southern red oak	5	<u>Quercus rubra</u> L.	Throughout the Delta but uncommon in the bottoms.	Confined to the higher loamy ridges in second or higher bottoms. (A common upland species.)	1, 4, 2.	Lumber and ties.
Cherrybark oak (swamp red oak in Sudworth).	1	<u>Quercus rubra pagodaefolia</u> (Elliot) Ashe and <u>Q. rubra leucophylla</u> Ashe	Throughout the Delta and frequently very common.	Occasional to predominant on almost all loamy ridges in both first and second bottoms and also rather common on washboardy or hummocky sites. Rare on clay ridges and on flats. Especially common on terraces in Arkansas.	4, 6, 1, 5, 2, 8.	Lumber, tight cooperage and some railroad and other heavy structural material.

WATER OAKS Water oak	3	<u>Quercus nigra</u> L.	Throughout the Delta on a great variety of sites but most common in the southern half (from central Arkansas southward). Only in the southern part of the Delta, probably not ranging much, if any, north of the Red River in Louisiana.	Most common on the border-line sites between typical flats and ridges and on silty clay or loamy ridges. May be found, however, on almost any other site. Somewhat more common in first bottoms than in second bottoms.	4, 12 (mainly on clay ridges), 5, 6, 1, 2, 8.	Lumber.
Water oak	5	<u>Quercus obtusa</u> Ashe	Only in the southern part of the Delta, probably not ranging much, if any, north of the Red River in Louisiana.	Within its restricted range, occasional to common on flats and washboard sites. Very rare on ridges.	9, 13, 6, 10, 8, 11.	Lumber. (But not preferred and probably seldom cut.)
Willow oak	1	<u>Quercus phellos</u> L.	Throughout the Delta, and frequently common to predominant.	Occasional to predominant on flats (especially loamy flats in second bottoms), washboard sites and local swags and drains. Rare on ridges, except clay ridges in first bottoms.	4, 6, 9, 5, 8, 10, 1, 13, 2.	Lumber and tight cooperage.
Laurel oak	5	<u>Quercus laurifolia</u> Michaux	Of doubtful occurrence in the southernmost part of the Delta.	On the edge of the bottoms (if in the bottoms at all).	?	Lumber. (But not preferred and rarely suitable for cutting.)
Shingle oak	5	<u>Quercus imbricaria</u> Michaux	Probably confined to the northern half of the Delta (above southern Arkansas).	On flats and low ridges, probably largely in second bottoms. (A tree principally of the lower Ohio River basin.)	1, 7, 2, 6.	Lumber.
Live oak	5	<u>Quercus virginiana</u> Miller	Confined to the southern edge of the Delta (along the Gulf Coast) but usually not properly in the bottoms.	On bayou banks, ridges and the borders of tidal marshes.	16.	Lumber for specialties, but rarely cut at all.

WHITE OAKS White oak (forked- leaf oak)	2	<u>Quercus alba</u> L.	Throughout the Delta, at least from central Louisiana northward. Only locally common. Most frequent in Arkansas. Probably throughout the Delta but only locally common (principally in and near West Carroll Parish, La.) Only in the northern part of the Delta, from about central Arkansas northward. (One or two specimens reported from La.) Throughout the Delta and very common.	Confined to the higher, loamy, better-drained ridges in second or higher bottoms, where it is sometimes locally common.	1, 4, 2.	Lumber, tight cooperage and railroad and heavy structural material.
Post oak	4	<u>Quercus stellata</u> Wang. and/or a variety and/or <u>Q. mississippiensis</u> Ashe <u>Quercus macrocarpa</u> Michaux	Probably throughout the Delta but only locally common (principally in and near West Carroll Parish, La.) Only in the northern part of the Delta, from about central Arkansas northward. (One or two specimens reported from La.) Throughout the Delta and very common.	Most common on washboardy or hummocky sites in both first and second bottoms, especially in the latter. Occasional on loamy ridges and loamy flats, usually in second bottoms. Fairly well distributed, and locally common, on washboardy or hummocky sites, flats and low ridges. In both first and second bottoms.	6, 8, 1, 2, 4 (rarely), and 7 (rarely).	Lumber.
Wurr oak	4	<u>Quercus macrocarpa</u> Michaux	Only in the northern part of the Delta, from about central Arkansas northward. (One or two specimens reported from La.) Throughout the Delta and very common.	Fairly well distributed, and locally common, on washboardy or hummocky sites, flats and low ridges. In both first and second bottoms.	6, 8, 9, 1, 11.	Lumber, ties and heavy structural material.
Overcup oak	3	<u>Quercus lyrata</u> Walter	Throughout the Delta and very common.	Very well distributed, and often very common or predominant, on flats--especially the lower, wetter, more impervious clay flats in first bottoms. Somewhat less common in second bottoms. Very common in swags and drains. Rare on ridges, except clay ridges in first bottoms.	13, 2, 6, 10, 8, 11, 7.	Lumber (on the poorest, wettest and most poorly-drained sites it is often of too poor quality to cut at all, but in the northern third of the Delta the quality is generally good).
Cow oak (swamp chestnut oak in Sudworth)	2	<u>Quercus prinus</u> L.	Throughout the Delta but rather locally distributed.	Locally common (and usually common where present at all) on washboardy or hummocky sites and on loamy ridges in both first and second bottoms. Rare on typical flats.	1, 6, 4, 8 (rarely)	Lumber, light cooperage, and railroad and heavy structural material.

Chinquapin oak	5	<u>Quercus muehlenbergii</u> Engelmann	Of doubtful occurrence in the northern part of the Delta, from about central Arkansas northward.	Probably only on ridges in second or higher bottoms.	Probably 1, 4, 2.	Lumber and ties.
American elm (white or red elm)	3	<u>Ulmus americana</u> L.	Common throughout the Delta.	Well distributed, but most common on cut-over flats; in both first and second bottoms but especially common in the former. Uncommon on loamy ridges but common on clay ridges in first bottoms.	10, 8, 9, 11, 6, 5, 13.	Slack cooperage. Crating. Barrel hoops. Lumber.
Winged elm	5	<u>Ulmus alata</u> Michaux	Probably throughout the Delta.	Confined almost entirely to second bottoms, principally on loamy flats, where it is often very common.	8, 6, 7, 1, 2, 4.	Same uses as American elm (directly above) but not preferred.
Cedar elm (rock elm)	5	<u>Ulmus crassifolia</u> Nuttall	Probably only from central Arkansas southward.	Well distributed and often common on flats, washboardy or hummocky sites and low clay ridges, in both first and second bottoms, but especially the former. Practically never found on loamy ridges. Often predominant on cut-over flats.	8, 10, 6, 13, 9, 7.	Lumber (but no established utilization and often too gnarled and knotty to cut at all).
Planer tree	6	<u>Planera aquatica</u> (Walter) Gmelin	Probably throughout the Delta.	Confined to swamps and sloughs, where it is often common in the scrubby understory of cypress brakes.	14, 15, 12 (only in swamps and sloughs), 11, 13.	Seldom large enough to cut but probably used for same purposes as elm.
Hackberry (Sugar-berry in Sudworth)	5	<u>Celtis laevigata</u> Willdenow	Common throughout the Delta.	Very well distributed over almost all first bottom flats and low clay ridges. Much less common on flats in second bottoms and very rare on the higher, loamy ridges. Often predominant on cut-over flats in first bottoms.	10, 9, 13, 11, 5, 8, 6.	Principally slack cooperage. Some lumber for cheap furniture and fixture stock and crating.

Red mulberry	5	<u>Morus rubra</u> L.	Probably throughout the Delta.	Confined largely to ridges (especially front ridges) in first bottoms and usually most common on the edges of the ridges where they grade off to flats. Never prominent or of much importance.	4, 5, 3.	Used only locally for fence posts.
Evergreen magnolia	5	<u>Magnolia grandiflora</u> L.	In the Delta, restricted to southern Louisiana.	Occasional on second bottom ridges, but found nowhere else in the Delta bottomlands. (A tree of the uplands, upland hammocks and minor stream bottoms.)	2, 4.	Lumber (of minor importance in the Delta because so rare).
Papaw	6	<u>Asimina triloba</u> (L.) Dunal	Probably throughout the Delta.	Confined largely to loamy ridges, in either first or second bottoms. Rarely of tree size but often common as a scrubby understory species.	1, 2, 4, 5.	Probably never cut due to small size and poor quality.
Red bay	6	<u>Persea borbonia</u> (L.) Sprengel	Restricted in the Delta to extreme southern Louisiana, along and near the Gulf Coast.	On the edges of swamps.	14, 15. (In both cases only along the edges, as a small shrub-like tree.)	Never cut in the Delta.
Swamp bay	6	<u>Persea pubescens</u> (Pursh) Sarg.	Probably restricted in the Delta to southeastern Louisiana, especially in the vicinity of Lakes Maurepas and Pontchartrain.	In swamps, often abundant in the understory.	14, 15. (In both cases, only a shrub to small tree.)	Never cut.
Sassafras	6	<u>Sassafras variifolium</u> (Salisbury) Kuntze	Probably throughout the Delta.	Confined to the higher loamy ridges in both first and second bottoms but principally the latter. Never common save very locally.	1, 2, 4, 5.	Hardly ever cut. Possibly some local use for posts.

Red gum (sweet gum)	1	<u>Liquidambar styraciflua</u> L.	Throughout the Delta. Probably the most widely distributed and generally most common single species in the Delta bottomlands. Very much more common in first than in second bottoms.	Frequent to abundant on the better drained flats, on washboardy sites, and on both clay and loamy ridges in the first bottoms. Much less widely distributed, but locally common, in second bottoms on washboardy sites and loamy ridges. Common on old fields. Rare on very wet, poorly drained tight clay flats.	5, 2, 4, 2, 1, 11, 6, 2.	Lumber for interior finish, cabinet work, furniture, auto bodies, etc. (almost everything except flooring). Slack cooperage. Crating and box shooks. ties.
Sycamore	4	<u>Platanus occidentalis</u> L.	Throughout the Delta.	Confined largely to sandy stream banks and local areas of fresh, sandy or silty river-wash. Most common on batture land. Occasional to common on old fields.	3, 12, 11, 5, 4.	Lumber for interior finish, furniture and box and crate stock. Slack cooperage.
Hawthorn	6	<u>Crataegus</u> sp. L. (There are undoubtedly dozens of species in the Delta but it does not appear practical to attempt separating them.)	Throughout the Delta.	Frequent to abundant in the understory on flats and low ridges, where the genus is most widely distributed. Much more common in first than in second bottoms, but may be found on almost any site in the Delta.	10, 8, 9, 11, 13, 7, 6. (Always a small understory species.)	Hardly ever cut; no commercial use.
Redbud	6	<u>Cercis canadensis</u> L.	Probably restricted in the Delta to the northern part, from about northern Louisiana northward.	Probably confined, in the Delta bottoms, to high, loamy ridges in second or higher bottoms, but rarely common. (Common on adjacent uplands and loessial ridges.)	1, 2, 4. (Always a small, understory species.)	Hardly ever cut except locally for fuel or fence posts.
Honey locust	5	<u>Gleditsia triacanthos</u> L.	Probably throughout the Delta.	On almost any site but not common anywhere and very locally distributed. Probably most common on flats and low clay ridges (especially front ridges) in first bottoms.	5, 9, 10, 8, 4.	Lumber for cheap furniture, auto bodies and interior finish. Ties and posts.

Water locust	6	<u>Gleditsia aquatica</u> Marshall	Probably throughout the Delta.	Confined to low, wet, clay flats and to swamps and sloughs and the edges of bayous. Locally very common fringing bayous and sloughs.	13, 14, 12 (almost entirely in swamps and sloughs).	Practically never cut.
Hercules club (prickly ash)	6	<u>Xanthoxylum clava-herculis</u> L.	In the Delta, probably only from about central Arkansas southward.	Very limited and irregular distribution but fairly common locally on moist, well-drained, loamy ridges in either first or second bottoms. (A small tree, rarely better than intermediate.) On the edges of swamps.	1, 4, 5.	Probably never cut.
Swamp iron-wood (red titi)	6	<u>Cyrilla racemiflora</u> L.	Probably restricted in the Delta to southeastern Louisiana, especially in the vicinity of Lakes Maurepas and Pontchartrain.		14, 15. (In both cases, usually only a shrub.)	Never cut.
Titi (black titi)	6	<u>Cliftonia monophylla</u> (La Marck) Sarg.	Probably restricted in the Delta to southeastern Louisiana, especially in the vicinity of Lakes Maurepas and Pontchartrain.	In swamps. Occasional, and rarely common, in the understory.	14, 15. (In both cases, a shrub to small tree.)	Never cut.
Holly	5	<u>Ilex opaca</u> Aiton	Probably throughout the Delta.	Confined largely to very moist but well-drained loamy ridges and to hummocky sites in either first or second bottoms. Very irregular distribution and only locally common. Very rare on poorly-drained flats.	4, 1. (Always as a small understory species)	Specialties (handle and shuttle stock, novelties, etc.). Usually cut in small bolts, but not widely used.
Dahoon	6	<u>Ilex cassine</u> L.	Restricted in the Delta to extreme southern Louisiana, along and near the Gulf Coast.	On the edges of swamps.	14, 15. (In both cases only along the edges, and frequently only a shrub.)	Never cut.

Yaupon	6	<u>Ilex vomitoria</u> Aiton	Restricted in the Delta to southern Louisiana, along and near the Gulf Coast.	On bayou banks and the edges of swamps and tidal marshes.	16 (common in the intermediate cover and usually only a shrub).	Never cut.
Winterberry (deciduous holly)	6	<u>Ilex decidua</u> Walter	Probably throughout the Delta.	Almost any moist site in either first or second bottoms. Rarely of tree size but often very common in the intermediate cover, especially on flats.	5, 7, 6, 10, 8, 9, 11, 13. (Always very small; often only a shrub.)	Never cut.
Silver maple	4	<u>Acer saccharinum</u> L.	Probably only from about the Louisiana-Arkansas line northward.	Frequent to common on loamy flats or low, very moist ridges, principally in the first bottoms. Also frequent in shallow swamps and sloughs and on the banks of streams.	8, 11, 3, 5, 6, 10.	Lumber for interior finish, furniture and auto bodies.
Red maple	5	<u>Acer rubrum</u> L. and <u>A. rubrum drummondii</u> (Hooker and Arnott) Sarg.	Throughout the Delta; the variety most common in southern Louisiana.	Very rare on tight clay flats. Well distributed and frequently common on low, wet flats and in swamps and sloughs. Rare on ridges. Most common in first bottoms.	8, 11, 5, 6, 10, 13, 14, 12.	Lumber and slack cooperage (but usually too poor or too small to cut at all).
Boxelder	5	<u>Acer negundo</u> L.	Throughout the Delta.	Generally infrequent but locally common on fresh, very moist but well-drained ridges. Rather common on batture land. In both first and second bottoms, but most frequent in the former.	5, 4, 3, 8, 10.	Slack cooperage and box and crate stock, but rarely cut at all.
Devil's walking-stick (Hercules club)	6	<u>Aralia spinosa</u> L.	In the Delta, probably only from northern Louisiana northward.	Very limited and irregular distribution, but often common locally on moist, well-drained, loamy ridges, principally in second bottoms. (A very small shrub-like tree.)	1, 4, 5.	Never cut.
Black gum	4	<u>Nyssa sylvatica</u> Marshall	Throughout the Delta.	Confined largely to moist, fairly well-drained loamy ridges in both first and second bottoms but principally the latter. Frequent, but rarely and only locally common.	1, 2, 4.	Lumber for furniture stock (frequently quartered). Ties.

Tupelo gum	2	<u>Nyssa aquatica</u> L.	Throughout the Delta but most common in southern Louisiana.	Widely distributed in extensive swamps and sloughs in southern Louisiana but very local northward and confined to small, deep sloughs and very wet swamps and swags (where it usually occurs in pure stands).	15, 14.	Boxes and crating. Wagon box-boards. Lumber for furniture and interior trim.
Dogwood (flowering dogwood)	5	<u>Cornus florida</u> L.	Probably throughout the Delta.	Confined entirely to the highest loamy ridges in second or higher bottoms and not common even there. (Very common on adjacent uplands and loessial ridges.)	1, 2, 4. (Always as a small understory tree.)	Specialties (small handle, shuttle and novelty stock). Usually cut in small bolts but not often cut at all in the Delta bottoms.
Roughleaf dogwood	6	<u>Cornus asperifolia</u> Michaux	Probably throughout the Delta.	Widely distributed on the better drained flats and on ridges in both first and second bottoms. Often very common in the intermediate cover.	1, 4, 5, 7, 6, 10, 8, 9, 11, 13. (Always as a very small shrub-like tree.)	Probably never cut.

Persimmon	3 (but a specialty wood and hardly to be classified on same basis as other species.)	<u>Diospyros virginiana</u> L.	Throughout the Delta.	Confined chiefly to low, wet clay or loamy flats where it is often a common to predominant understory species. In both first and second bottoms. Also common on very moist old fields.	10, 8, 13, 7, 6, 9.	Cut principally into short bolts for shuttles, golf club heads and novelties.
White ash	2	<u>Fraxinus americana</u> L.	Probably throughout the Delta.	Probably confined very largely to moist well-drained loamy ridges in second bottoms. Locally common. (Since white and green ashes are often difficult to distinguish between, the site preferences of each as given here may not be absolutely correct.)	1, 4, 2, 6, 11 (mainly in northern Arkansas only), 5, 8 (on terraces)	Lumber. Many specialties (such as vehicle stock and athletic goods). Slack cooperage.
Green ash	1	<u>Fraxinus pennsylvanica lanceolata</u> (Bork.) Sarg.	Throughout the Delta.	Probably confined largely to flats in both first and second bottoms, where it is often very common, especially on cut-over flats in first bottoms. Rare on ridges except low clay ridges in first bottoms.	8, 9, 13, 10, 5, 7, 6, 11.	Same as white ash (directly above).
Swamp privet	6	<u>Forestiera acuminata</u> (Michaux) Poiret	Throughout the Delta.	On flats and in swamps and sloughs, principally in first bottoms. A small, very shrub-like tree often common in the intermediate cover.	13, 8, 9, 11, 14, 7, 6, 10.	Never cut.

OTHER SPECIES

A.

Species of which comparatively few specimens have been found by the authors in the Delta bottomlands and which hardly warrant more than mention. They are:

1. Yellow poplar - Liriodendron tulipifera L. (a few small seedlings found on a high second bottom ridge in West Carroll Parish, Louisiana).
2. Black cherry - Prunus serotina Ehrhart (reported from very high, loamy second or higher bottoms and found on upland "islands" in the Delta).
3. Kentucky coffee-tree - Gymnocladus dioica (L.) Koch (found on batture land, Tunica County, Miss.).
4. Black locust - Robinia pseudoacacia L. (in and escaped from a number of plantations on farms in Louisiana).
5. Chinaberry - Melia azedarach L. (occasionally escaped from farm plantings; naturalized from India and the most common tree in farm house and cabin yards in the Delta).
6. Basswood - Tilia sp. L. (occasional on loamy second bottom or high terrace ridges in southern Louisiana).
7. Swamp black gum - Nyssa biflora Walter (in the Delta, probably confined to the swamps near Lake Maurepas, southeastern Louisiana).
8. Water ash - Fraxinus caroliniana Miller (reported from a swamp near the Red River in the vicinity of Alexandria, Louisiana).
9. Hardy catalpa - Catalpa speciosa Warder (occasional on second bottom ridges in the central Arkansas Delta and in southern Louisiana. Often planted and occasionally escaped.)

B.

Species possibly found in the Delta bottomlands but not yet reliably reported as far as known:

1. Bitter pecan - Hicoria texana (LeConte) Britton.
2. Hackberry - Celtis occidentalis L. (possibly in southeastern Missouri).
3. Pumpkin ash - Fraxinus profunda Bush (possibly in southeastern Missouri, eastern Arkansas and southern Louisiana).

C.

Species found on islands of upland within the Delta region (e.g. Sicily Island, Catahoula Parish, Louisiana and Crowley's Ridge in Arkansas and Missouri) and on uplands bordering the Delta region but probably never found in the Delta bottomlands proper (except possibly on extremely high terraces):

1. Hop-hornbeam - Ostrya virginiana (Miller) Koch.
2. Beech - Fagus grandifolia Ehrhart.
3. Witch-hazel - Hamamelis macrophylla Pursh.

EXPLANATION OF COLUMN HEADINGS IN TABULAR OUTLINE

^aListed in the order and by the nomenclature given by G. E. Sudworth (Check List of the Forest Trees of the United States, Their Names and Ranges. U. S. Department of Agriculture Misc. Cir. 92, issued March, 1927). The few exceptions in the common names are noted.

^bThe numbers show approximate degrees of commercial importance within the Delta:

(1) Primary, with species widely and more or less abundantly distributed.

(2) Primary, but species not abundant except locally.

(3) Secondary, with species widely and more or less abundantly distributed.

(4) Secondary, but species not abundant except locally.

(5) Minor.

(6) No commercial use.

^cA species is considered to range "throughout the Delta" if the entire lower Mississippi River valley or Delta region lies within the extreme boundaries of its geographic range. Certain species, e.g., southern red oak, Quercus rubra L., have a geographic range which includes the entire Delta region, yet in the Delta bottomlands (practically but not entirely synonymous with Delta region because a few local islands and ridges of upland occur within the alluvial valley proper) such species may be very uncommon. The point is that such trees may be found anywhere within the Delta region on favorable sites merely because the Delta region lies wholly within their natural geographic

range. The facts in each case are explained fully in the adjacent column, which gives "distribution and habitat in the Delta bottomlands".

^dThe numbers refer to the forest cover types in which the species is found more or less regularly and typically, in the approximate order of their importance. The types given first are those in which the species is most common, and the one or two unusually important types, if any, are underlined or double-underlined for emphasis. No attempt is made, however, to name all the types in which each species occurs, but only the more representative types. For complete type descriptions, see pages 33-54. The types, except the last (#16), which is in a class by itself and hardly comparable with the others, are listed in the approximate order of increasing wetness of site.

1. Oak-hickory.
2. Loblolly pine-hardwood.
3. Cottonwood.
4. Red gum-loamy ridge oaks.
5. Red gum.
6. Willow oak-cherrybark oak-cow oak.
7. Willow oak.
8. Oak-elm-ash.
9. Red gum-clay land oaks.
10. Hackberry-elm.
11. Southern cypress-hardwood.
12. Willow.
13. Overcup oak-water hickory.
14. Southern cypress.
15. Tupelo gum.
16. Live oak.

^o It should be understood that "lumber", when listed in this column, refers to an industrial raw material subject to refabrication at factories or other wood-working plants into any of the multitude of articles made wholly or partly of wood. Nearly all hardwood lumber is utilized as such factories, and, conversely, a very large part of all lumber so utilized is hardwood. The small proportion of hardwood sawmill production not so utilized is adequately covered by specific mention of ties and railroad and heavy structural material. Except in special cases, the specific uses of "lumber" of each species are not given, because they are too numerous and too varied to quote in full.

FOREST COVER TYPES IN THE DELTA BOTTOMLANDS

Forest cover types in the Delta bottomlands are strongly correlated with site. The general scheme of distribution is shown in Table 1. In the following descriptions of each type, the nomenclature of the tree species follows that of G. E. Sudworth in U. S. Department of Agriculture Misc. Cir. 92, "Check List of the Forest Trees of the United States", 1927, except in the case of certain common names marked with an asterisk. In these cases, the common names widely used throughout the Delta are substituted for the academic names given by Sudworth.

The names of the types occasionally differ from the names selected by the Committee on Forest Types of the Society of American Foresters and presented in a report submitted at the annual meeting in New Orleans, December 30, 1931. All such differences are noted and the Committee's name is given in each instance. The number of each type, as it appears in the Committee's Report of December 30, 1931, is likewise given.

No attempt has been made to list all the tree species ever found or possible to find in each type as conceived. Only the more common and more representative species are listed.

Under "place in succession", the term "climax" is used in the sense of an edaphic climax, not a climatic climax.

These are not the forest types used by the Forest Survey in the Delta. The Forest Survey types are listed and explained on page 35.

The Nature of the Types and the Purpose of Their Presentation

The sixteen forest types named and described here are tree associations, combinations of species that occur together. Naturally, the number of different specific associations or combinations that can be found in the Delta is infinite.

Table 1
Distribution of Forest Cover Types in the Mississippi River Delta Region

Forest Cover Type	First Bottoms							Swags and Drains	Swamps and Sloughs	Second Bottoms			Borders of Tidal Marshes	
	River Margins	Loamy Ridges	Clay Ridges	Washboardy Sites	Flats ^a	Very low, drained, tight clay flats	Loamy Flats ^a			Loamy Ridges	Washboardy Sites	Loamy Flats ^a		
Frequency of Occurrence*														
1. Oak-hickory		2		1							4	2	2 ^d	
2. Loblolly pine-hardwood												2		
3. Cottonwood	4	2 ^b												
4. Red gum-loamy ridge oaks		4		2							3	1		
5. Red gum		3	4	2 + 2				2					2	
6. Willow oak-cherrybark oak-cow oak				4								4		
7. Willow oak								2				3	4	
8. Oak-elm-ash				2	4	2		2				2	2	
9. Red gum-clay land oaks			4	2	4	1		2				1	2	
10. Hackberry-elm			2	2	4	2							2	
11. Southern cypress-hardwood			1	2	3 ^c	1		3	2					
12. Willow	4							1	3					
13. Overcup oak-water hickory					2	4							2	
14. Southern cypress	1				1			3	2					
15. Tupelo gum									4					
16. Live oak									4					4

*Legend: 1 - rare; 2 - occasional; 3 - common; 4 - very common.

Footnotes:

^aFlats in both first and second bottoms vary considerably both in texture of soil and in drainage and accordingly support nearly as great a variety of types as the washboardy or hummocky sites which are a mixture of ridge and flat conditions. Types featured by red gum, cypress and elm occupy the flats with the more pervious soils and the quality and growth of the oaks is better on such flats than on the very impervious flats.

^bMainly old fields on front ridges.

^cMainly in northern Arkansas and southern Louisiana.

^dOnly in Arkansas and Missouri.

The exact composition varies considerably from one acre to another in the most homogeneous-appearing forest land, yet for all practical purposes--e.g., for readily distinguishing the characteristic association represented in the stand as a whole from a different, equally characteristic association of another stand--only a single broad cover type need be recognized in such a case.

The cover types given here are based primarily on the species, genus or genera of trees most prominent in the dominant crown canopy and are named on this basis. The secondary basis is that of site, but since site strongly influences and often determines the association, this secondary basis, in practice in unusually complicated mixtures of species, often becomes the most important single factor in recognizing the broad cover type. The types therefore differ from one another in both floristic (or dendrological) composition and ecological adaptation. The names of the types have purposely been made as brief as possible, and in name only many of the types may be considered artificial. The authors believe, however, that the descriptions are in no sense artificial but represent the average composition of very real and distinct associations, innumerable examples of which can be found in the Delta. Naturally, one must not expect to find every species listed under a given type in every example of that type encountered, and local variations in abundance or absence or grouping of component species must be given due allowance.

The purpose of setting up and describing cover types in this report is merely to acquaint the reader with what appear to the authors to be the outstanding, distinctive, broad associations of trees in the Delta. It is felt that the reader gains a better and more useful picture of the Delta tree species if he has associations or cover types to which the individual species

can be tied, if he knows the relative importance and abundance of each tree compared with others with which it occurs, if he knows the distribution of the broad associations or cover types containing the different species, and if he knows the nature of the sites occupied by these distinctive associations.

With hundreds of combinations possible, it can at once be seen that the sixteen selected for presentation and description must either be exceedingly broad (perhaps so broad as to be meaningless) in order to make it logically possible to include all specific and local combinations under one or another cover type, or they must take care of only a portion of the forest stands of the Delta. The sixteen given here have been criticized as being artificial (hence difficult to recognize) and, as it were, neither fish, flesh nor fowl--this last in the sense that the types are neither sufficiently condensed and reduced in number to be really simple and broad, nor numerous and specific enough either to take care of certain associations that are claimed to be of parallel importance with those named, or to be of great ecological or silvicultural value. These criticisms are not without foundation, but the authors believe that at the present time, with the present knowledge of the Delta forests and with the purposes quoted above in mind, the given tentative types are the best that can be presented. No use is being made of these types in the present work of the Southern Forest Experiment Station and none is contemplated in the near future. The transition from one type to another is usually too gradual and too intangible to make type mapping practicable--a difficulty, incidentally, by no means confined to the types under discussion. For the present they are useful merely as a guide to the silvical and ecological study of the Delta tree species.

●OAK-HICKORY

(Type #83, hickory-swamp chestnut oak-white oak, in Type Committee's List)

Composition

Predominants

Hickories (including at least the following, only one or two of which are usually common in a given stand). For convenience they may be grouped as "terrace hickories" because of their preference for second bottom or terrace sites.

Bitternut hickory - Hicoria cordiformis (Wang.) Britton

Nutmeg hickory - Hicoria myristicaeformis (Michaux f.) Britton

Shagbark hickory - Hicoria ovata (Miller) Britton

Bigleaf shagbark hickory - Hicoria laciniosa (Michaux f.) Sarg.

Mockernut hickory - Hicoria alba (L.) Britton

Pignut hickory - Hicoria leiodemis (Sarg.) Sudw.

*Cow oak - Quercus prinus L.

White oak - Quercus alba L.

Post oak - Quercus stellata Wang. or a variety or
Quercus mississippiensis Ashe

*Cherrybark oak - Quercus rubra pagodaefolia (Elliott) Ashe and
Q. rubra leucophylla Ashe

Chief Associates

Water oak - Quercus nigra L.

White ash - Fraxinus americana L.

American elm - Ulmus americana L.

Winged elm - Ulmus alata Michaux (only in second bottoms)

Red gum - Liquidambar styraciflua L.

Black gum - Nyssa sylvatica Marshall

Minor Associates

Willow oak - Quercus phellos L.

Southern red oak - Quercus rubra L.

Persimmon - Diospyros virginiana L.

Etc.

●Occurrence

Most common on high loamy ridges but occasional to common on hummocky sites (largely in second bottoms) and, in the northern part of the Delta, occasional to common on loamy flats. Much more common in second bottoms than in first bottoms and especially common in Arkansas and Mississippi.

Place in Succession

Probably climax.

Importance

Important only locally; widely distributed, not found over extensive single areas, but with a large aggregate area.

Local Sub-types and Variants

Probably no one species of oak or hickory predominates except locally, and many different associations are found.

2. LOBLOLLY PINE-HARDWOOD

(Types #69, 70, 71, loblolly pine, loblolly pine-southern red oak, and loblolly pine-white oak, respectively, in Type Committee's List probably include this type)

Composition

Predominants

Loblolly pine - Pinus taeda L.

White oak - Quercus alba L.

Post oak - Quercus stellata Wang. or variety or

Quercus mississippiensis Ashe

Black gum - Nyssa sylvatica Marshall

Southern red oak - Quercus rubra L.

Water oak - Quercus nigra L.

Associates

*Cherrybark oak - Quercus rubra pagodaefolia (Elliott) Ashe and
Quercus rubra leucophylla Ashe

Hickories - Hicoria sp. (see list in Type #1)

Red gum - Liquidambar styraciflua L.

Etc.

Occurrence

Restricted to high second bottoms, on loamy ridges or loamy washboard sites. Not common, save locally as on certain portions of Macon Ridge, northeastern Louisiana.

Place in Succession

Probably temporary.

Importance

Of little importance due to infrequent occurrence.

COTTONWOOD

(Type #61 in Type Committee's List)

Composition

Predominants

Southern cottonwood - Populus deltoides virginiana (Castiglioni) Sudw.

Chief Associates

Sycamore - Platanus occidentalis L.

Red gum - Liquidambar styraciflua L.

Red maple - Acer rubrum L.

Black willow - Salix nigra Marshall and variety altissima Sarg.
and other willows

*Hackberry - Celtis laevigata Willdenow

Etc.

Occurrence

Very common on batture land (i.e., land between levee and river), on the higher, sandier, better-drained sites.

Also common on old fields, principally on sandy or well-drained clay front ridges. Cottonwood needs bare soil for germination and seldom comes in on old pasture land.

Place in Succession

Temporary. When the older trees die or are cut, the stand is usually replaced by a type in which red gum is common to predominant. Possible exceptions are overflowed sand bars and flats in the batture land, i.e., sites subject to the washing and scouring action of large streams.

Importance

Very important along the Mississippi River and the larger tributary streams.

Local Sub-types and Variants

Cottonwood-red gum

Cottonwood-sycamore

Cottonwood-willow

4. RED GUM-LOAMY RIDGE OAKS

(Type #81, red gum-swamp red oak, in Type Committee's List)

Composition

Predominants

- Red gum - Liquidambar styraciflua L.
*Cherrybark oak - Quercus rubra leucophylla Ashe and Q. rubra
pagodaefolia (Elliott) Ashe
*Cow oak - Quercus prinus L.
Water oak - Quercus nigra L.

Chief Associates

- Isa (probably largely Fraxinus americana L.)
Post oak - Quercus stellata Wang. or a variety or Q.
mississippiensis Ashe
Hickories - Hicoria sp. (several species, but not water hickory)
Black gum - Nyssa sylvatica Marshall

Minor Associates

- White oak - Quercus alba L.
Honey locust - Gleditsia triacanthos L.
Shumard red oak - Quercus shumardii Buckley
American elm - Ulmus americana L.
Winged elm - Ulmus alata Michaux (only in second bottoms)
Southern red oak - Quercus rubra L.
Blue beech - Carpinus caroliniana Walter
Pecan - Hicoria pecan (Marshall) Britton
Etc.

Occurrence

On ridges, distinctly elevated above typical flats. The soil is a silty clay, silty clay loam, silt loam or sandy loam, and fairly well to well drained. These ridges may be either extensive or much interrupted by intervening low flats supporting a different type. The site is usually never covered with standing water and rarely if ever overflowed except at times of exceptionally high water, as in 1927. In both first and second bottoms.

Place in Succession

Climax.

Importance

Very important, due to its very extensive distribution and abundance in both small and large areas, and to the value of the principal species.

Local Sub-types and Variants

Any one or two of the predominant species or the chief associates may be most prominent on any given area. Red gum-cow oak, cherrybark oak-water oak and red gum-cherrybark oak are common sub-types.

RED GUM

(Type #82 in Type Committee's List)

Composition

Predominants

Red gum - Liquidambar styraciflua L.

Chief Associates

Water oak - Quercus nigra L.

*Nuttall oak - Quercus nuttallii Palmer

American elm - Ulmus americana L.

Willow oak - Quercus phellos L.

*Hackberry - Celtis laevigata Willdenow

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

Minor Associates

Pecan - Hicoria pecan (Marshall) Britton

Honey locust - Gloditsia triacanthos L.

Southern cottonwood - Populus deltoides virginiana (Castiglioni) Sudw.

Red maple - Acer rubrum L.

Persimmon - Diospyros virginiana L.

Shumard red oak - Quercus shumardii Buckloy

Red mulberry - Morus rubra L.

Sycamore - Platanus occidentalis L.

Water hickory - Hicoria aquatica (Michaux f.) Britton

Hawthorn - Crataegus sp.

Box elder - Acer negundo L.

White ash - Fraxinus americana L.

Etc.

Occurrence

Common on high clay flats and low clay or loamy ridges throughout the first bottoms. The soils are usually silty or loamy and where a clay top soil occurs it is usually underlain by a sandy or loamy subsoil. Also very common on old fields, once cultivated, where there is abundant moisture but the site is well-drained (usually on front ridges). Rare to occasional in second bottoms and in very shallow swags and drains.

Place in Succession

Probably climax.

Importance

Very important, due to the wide distribution and to the value of the species.

F. WILLOW OAK-CHERRYBARK OAK-COW OAK
(Not included in Type Committee's List)

Composition

Predominants

- Willow oak - Quercus phellos L.
*Cherrybark oak - Quercus rubra leucophylla Ashe and Q. rubra pagodaefolia (Elliott) Ashe.
*Cow oak - Quercus prinus L.
Post oak - Quercus stellata Wang. or a variety or Q. mississippiensis Ashe
*Nuttall oak - Quercus nuttallii Palmer
Overcup oak - Quercus lyrata Walter
Water oak - Quercus nigra L.
Water oak - Quercus obtusa Ashe (only in southern and central Louisiana)

Associates

- Red gum - Liquidambar styraciflua L.
American elm - Ulmus americana L.
Winged elm - Ulmus alata Michaux (only in second bottoms)
Cedar elm - Ulmus crassifolia Nuttall (principally in first bottoms)
Shumard red oak - Quercus shumardii Buckley
Ash - probably chiefly Fraxinus pennsylvanica lanceolata (Bork.) Sarg.
Persimmon - Diospyros virginiana L.
Water hickory - Hicoria aquatica (Michaux f.) Britton
Honey locust - Gleditsia triacanthos L.
*Hackberry - Celtis laevigata Willdenow
Etc.

Occurrence

Principally on sites having characteristics (of soil, moisture, elevation and overflow) midway between those of typical flats and typical ridges. The topography is undulating, washboardy, or hummocky with a resultant mixture of flat and ridge conditions, and on hummocky sites in particular the soil is usually loose and mushy. Well distributed throughout the Delta, in both first and second bottoms. The occurrence of willow oak and cherrybark oak together, and of cow oak, Nuttall oak, Quercus obtusa and overcup oak together are good indications of this type.

Place in Succession

Probably climax.

Importance

A very common type but one not ordinarily covering very large individual areas. Fine post oak and cow oak are cut in this type and it is, in fact, a principal source of cow oak in the Delta.

Local Sub-types and Variants

Grades into types containing red gum and either the oaks of the flats or those of the ridges. When heavily cut over, it commonly changes to the oak-elm-ash type. Due to the prevalence of heavily

cut-over areas, the oak-elm-ash type is the more common of the two and probably covers a very much larger aggregate area.

The type is indicated in all stands predominated by oaks of two or three or more species not usually found together on either typical flats or typical ridges; in certain respects "mixed oaks" would be a more useful and perhaps less misleading name. The oaks as a group at least equal and usually far exceed in both numbers and volume all other species together. The type by no means requires the largest proportion or even the presence of each of the three oaks given in the type name; the different associations are numerous and varied and they depend largely on geographic location, the character of the soil and drainage and whether the site is in the first bottoms or in the second bottoms. The three oaks given in the type name are merely the most generally common and probably the most characteristic and important. One or two of the first five oaks named above are usually locally predominant.

7. WILLOW OAK

(Type #23 in Type Committee's List)

Composition

Predominants

Willow oak - Quercus phellos L.

Associates

*Nuttall oak - Quercus nuttallii Palmer

Winged elm - Ulmus alata Michaux (only in second bottoms)

Cedar elm - Ulmus crassifolia Nuttall (principally in first bottoms)

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

Persimmon - Diospyros virginiana L.

Etc.

Occurrence

Almost entirely on poorly-drained loamy flats, or in swags, in second bottoms, where it is widely distributed and very common. The stand is almost invariably 80 per cent or more willow oak and is generally rather open. The flats supporting this type, often known locally as "pin oak flats" (pin oak being a common local name for willow oak), are usually covered with a shallow sheet of water throughout the winter and early spring. The soil usually contains considerable clay and is rather mushy.

Place in Succession

Probably climax.

Importance

Important mainly because of the large aggregate area, but the quality of timber produced is usually poor.

Composition

Predominants (the order given has no significance)

*Nuttall oak - Quercus nuttallii Palmer

Willow oak - Quercus phellos L. (principally in second bottoms)

Overcup oak - Quercus lyrata Walter

Post oak - Quercus stellata Wang. or variety or Q. mississippiensis Ashe

*Cherrybark oak - Quercus rubra leucophylla Ashe and Q. rubra pagodaefolia (Elliott) Ashe

Water oak - Quercus nigra L.

Water oak - Quercus obtusa Ashe (only in southern and central Louisiana)

American elm - Ulmus americana L.

Winged elm - Ulmus alata Michaux (only in second bottoms)

Cedar elm - Ulmus crassifolia Nuttall.

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

Associates

*Hackberry - Celtis laevigata Willdenow

Red maple - Acer rubrum L. and var. drummondii (Hook. and Arn.) Sarg.

Persimmon - Diospyros virginiana L.

Water hickory - Hicoria aquatica (Michaux f.) Britton

Red gum - Liquidambar styraciflua L.

Honey locust - Gleditsia triacanthos L.

Hawthorn - Crataegus sp. (of no commercial importance and always small, but usually very common)

White ash - Fraxinus americana L.

Etc.

Occurrence

Extensively distributed on flats, low ridges and washboard sites and in swags and drains in both first and second bottoms; most common on cut-over clay flats and low ridges in first bottoms, and on cut-over flats, washboard sites and low ridges in second bottoms. Often replaces red gum-clay land oaks and willow oak-cherrybark oak-cow oak types after heavy cutting. Common where shallow sheets or small pools of water stand on the site through the winter and early spring.

Place in Succession

Usually temporary - a residual type following cutting in original climax types. Sometimes, however, instead of being merely what remains after moderate cutting, it is a new or succeeding type that originates from young growth coming in after very heavy cutting.

Importance

Valuable principally as both a present and potential future source of considerable ash.

Local Sub-types and Variants

The entire list of species given above is rarely found in any

one instance of the type except on washboardy or hummocky sites and even there it is unusual to find so many species within a reasonably small area. The combinations of species, or associations, actually found depend on the character of the site, the nature of the cutting and the original association. The oaks are generally most important and at the same time most variable in their distribution. Locally, any one or more species of oak, elm or ash may occur in practically pure stands over small areas. Some of the more common of the numerous sub-types are:

Nuttall oak-water oak (<u>Quercus obtusa</u>)-green ash)	especially
Green ash	) on flats
Green ash-red maple-American elm	) and wash-
Willow oak-cedar elm (especially common in Ark-ansas)	) boardy
	) sites in
Cedar elm	) first bottoms

Willow oak-water oak (<u>Quercus nigra</u>)-elm-ash)	especially on low
Post oak-cherrybark oak-elm-ash	) ridges in second
	) bottoms

RED GUM-CLAY LAND OAKS

(Type #86, red gum-Nuttall oak-willow oak, in Type Committee's List)

Composition

Prodominants

Red gum - Liquidambar styraciflua L. (generally not as common as the oaks)

*Nuttall oak - Quercus nuttallii Palmer

Willow oak - Quercus phellos L.

Pin oak - Quercus palustris Muench. (only from about the Louisiana-Arkansas line northward)

Chief Associates

Overcup oak - Quercus lyrata Walter

Water oak - Quercus obtusa Ashe (only in central and southern Louisiana)

Burr oak - Quercus macrocarpa Michaux (same approximate range as pin oak)

American elm - Ulmus americana L.

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

Minor Associates

Honey locust - Gleditsia triacanthos L.

*Hackberry - Celtis laevigata Willdenow

Persimmon - Diospyros virginiana L.

Water hickory - Hicoria aquatica (Michaux f.) Britton

Hawthorn - Crataegus sp. (of no commercial importance and always small, but very common)

Cedar elm - Ulmus crassifolia Nuttall

Water oak - Quercus nigra L.

Etc.

Occurrence

Very common on clay flats or in swags, where a shallow sheet of water usually stands during the winter, and on low clay ridges in first bottoms. Occasional on loamy flats in second bottoms and on washboardy sites. Rare on the most poorly drained, most impervious, tight clay flats in the first bottoms. The most common oak in this type and the one best considered as an indicator species is Nuttall oak (Quercus nuttallii Palmer).

Place in Succession

Climax.

Importance

Very important on flats in first bottoms. Contains several valuable timber species and is very widely distributed. One of the principal sources of hardwood lumber in the Delta during the past 10 years.

10. HACKBERRY-ELM

(Type #84, sugarberry-elm, in Type Committee's List)

Composition

Predominants

*Hackberry - Celtis laevigata Willdenow

American elm - Ulmus americana L.

Cedar elm - Ulmus crassifolia Nuttall

Winged elm - Ulmus alata Michaux (only in second bottoms, where the type is rare)

Associates

Depend largely on type previous to cutting, but generally include the following:

Water hickory - Hicoria aquatica (Michaux f.) Britton

*Nuttall oak - Quercus nuttallii Palmer

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

Red gum - Liquidambar styraciflua L.

Occurrence

Usually a residual type found after heavy cutting. May occur almost anywhere except in sloughs, along bayou fronts or in deep swamps, but by far the most common on poorly-drained flats in first bottoms and rather rare in second bottoms. It commonly succeeds the red gum-clay land oaks type after removal of the gum and best oak.

Place in Succession

Usually temporary.

Importance

Of little value or entirely worthless commercially, but very wide-spread and from that viewpoint important. When the original and only cutting on the site has been for lumber mill material, a cutting in the residual hackberry-elm type for slack cooperage usually yields a moderate return.

SOUTHERN CYPRESS-HARDWOOD

(Type #87 in Type Committee's List)

Composition

Predominants

- Southern cypress - Taxodium distichum (L.) Richard
Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.
Red gum - Liquidambar styraciflua L.
Red maple - Acer rubrum L. and var. drummondii (Hook. and Arn.)
Sarg.
Silver maple - Acer saccharinum (only from northern Louisiana
northward)
American elm - Ulmus americana L.

Chief Associates

- Overcup oak - Quercus lyrata Walter
*Nuttall oak - Quercus nuttallii Palmer
Water hickory - Hicoria aquatica (Michaux f.) Britton
Pin oak - Quercus palustris Muench. (same approximate range as
silver maple)
*Hackberry - Celtis laevigata Willdenow

Minor Associates

- Willow oak - Quercus phellos L.
Sycamore - Platanus occidentalis L.
Persimmon - Diospyros virginiana L.
Water oak - Quercus obtusa Ashe (only in central and southern
Louisiana)

Etc.

Occurrence

This association is found principally on areas in the first bottoms where water stands at frequent intervals but which are low flats rather than swamps. The soil is generally either a clay or a silty clay loam. The cypress is ordinarily without knees or with knees of low height. It is probably most common in northeastern Arkansas and southern Louisiana.

Also found occasionally on clay ridges in first bottoms, and frequently in swags, drains and sloughs.

Place in Succession

Probably temporary - with the cypress gradually replaced by hardwoods.

Importance

Of considerable importance in northeastern Arkansas and southern Louisiana, but usually of only minor importance elsewhere.

Local Sub-types and Variants

Cypress-overcup oak, cypress-red gum, cypress-ash, and cypress-elm-maple are among the common sub-types. When the cypress is cut out, the type usually becomes red gum-clay land oaks.

12. WILLOW

(Type #88 in Type Committee's List)

Composition

Predominants

Black willow - Salix nigra Marshall and var. altissima Sarg.
Sandbar willow - Salix longifolia Muehl. (not very common)
Several other species of willow

Associates

Southern cottonwood - Populus deltoides virginiana (Castiglioni) Sudw.

Swamp privet - Forestiera acuminata (Michaux) Poiret

Water locust - Gleditsia aquatica Marshall

Southern cypress - Taxodium distichum (L.) Richard (principally only in swamps and sloughs)

Etc.

Occurrence

As pure stands along river margins, on river bars, and on low batture land, usually annually overflowed. Also common in shallow swamps and sloughs, old drainage ditches, etc.

Place in Succession

Temporary - replaced by other types as the soil is built up.

Importance

Very extensive along the Mississippi, Red, Yazoo, Atchafalaya and other large rivers in the Delta.

3. OVERCUP OAK-WATER HICKORY
(Type #89 in Type Committee's List)

Composition

Predominants

Overcup oak - Quercus lyrata Walter
Water hickory - Hicoria aquatica (Michaux f.) Britton

Chief Associates

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.
Willow oak - Quercus phellos L.
Persimmon - Diospyros virginiana L.
*Nuttall oak - Quercus nuttallii Palmer
American elm - Ulmus americana L.
Red maple - Acer rubrum L. and var. drummondii (Hook. and Arn.)
Sarg.

Cedar elm - Ulmus crassifolia Nuttall

Minor Associates

Southern cypress - Taxodium distichum (L.) Richard
Red gum - Liquidambar styraciflua L.
Water oak - Quercus obtusa Ashe (only in southern and central
Louisiana)
Water oak - Quercus nigra L.
*Hackberry - Celtis laevigata Willdenow
Water locust - Gleditsia aquatica Marshall
Hawthorn - Crataegus sp.
Etc.

Occurrence

On poorly-drained clay flats in first bottoms, principally in Louisiana and Mississippi, and in poorly-drained depressions, sloughs and shallow swamps throughout the Delta, especially the southern half. This type is practically the only one that occupies the lowest, wettest and most poorly-drained, impervious clay flats.

Place in Succession

Climax.

Importance

Secondary with respect to the poor form and slow growth of the trees but primary with respect to the large aggregate area. Both principal species are often of too poor quality to cut.

Local Sub-types and Variants

Water hickory alone is frequently predominant over small areas of suitable site.

14. SOUTHERN CYPRESS

(Type #94 in Type Committee's List)

Composition

Predominants

Southern cypress - Taxodium distichum (L.) Richard

Chief Associates (generally of little value)

Tupelo gum - Nyssa aquatica L.

Planer tree - Planora aquatica (Walter) Gmelin

Willow - Salix nigra Marshall and others

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

*Hackberry - Celtis laevigata Willdenow

Overcup oak - Quercus lyrata Walter

Minor Associates

Red maple - Acer rubrum L. and var. drummondii (Hook. and Arn.) Sarg.

Silver maple - Acer saccharinum L. (only from northern Louisiana northward)

American elm - Ulmus americana L.

Honey locust - Gleditsia triacanthos L.

Swamp privet - Forestiera acuminata (Michaux) Poiret

Box elder - Acer negundo L.

Water hickory - Hicoria aquatica (Michaux f.) Britton

Persimmon - Diospyros virginiana L.

Water locust - Gleditsia aquatica Marshall

●ccurrence

In swamps, sloughs and margins of bayous and lakes, principally in southern and central Louisiana. Very widely distributed in southern Louisiana but local elsewhere. The stand is usually practically pure cypress and the associated species are largely in an understory of poorly-formed, small trees with the exception of tupelo gum in the deeper swamps and sloughs, which competes directly with the cypress.

Place in Succession

Climax.

Importance

Nearly all the commercial cut of cypress comes from this type.

Local Sub-types and Variants

Cypress-willow (usually the result of cutting most of the original cypress)

15. TUPELO GUM

(Type #95 in Type Committee's List)

Composition

Predominants

Tupelo gum - Nyssa aquatica L.

Chief Associates

Southern cypress - Taxodium distichum (L.) Richard

Minor Associates

Red maple - Acer rubrum L. and var. drummondii (Hook. and Arn.)
Sarg.

American elm - Ulmus americana L.

Green ash - Fraxinus pennsylvanica lanceolata (Bork.) Sarg.

Willow - Salix nigra Marshall and others

Planer tree - Planera aquatica (Walter) Gmelin

Etc.

Occurrence

In deep swamps, sloughs, and margins of bayous, principally in southern and central Louisiana and often as residual stand after cypress has been cut. Very widely distributed in southern Louisiana, but local elsewhere. As indicated above, the stands tend toward pure tupelo gum; they are also generally even-aged and dense. Tupelo usually is found in deeper water than cypress.

Place in Succession

Intermediate or climax.

Importance

The large aggregate area and general high yield per acre make this type of considerable importance.

16. LIVE OAK

(Type #78 in Type Committee's List)

Composition

Predominants

Live oak - Quercus virginiana Miller

Associates

Water oak - Quercus nigra L.

Red gum - Liquidambar styraciflua L.

Holly - Ilex opaca Aiton

Yaupon - Ilex vomitoria Aiton

*Cherrybark oak - Quercus rubra leucophylla Ashe and Q. rubra
pagodaefolia (Elliott) Ashe

American elm - Ulmus americana L.

Black gum - Nyssa sylvatica Marshall

Etc.

Occurrence

Restricted to well-drained borders of tidal marshes, low narrow ridges between cypress and tupelo sloughs, and well-drained bayou banks in southern Louisiana. This type is essentially a scrubby form of red gum-loamy ridge oaks in which live oak is very prominent.

Place in Succession

Probably climax.

Importance

Of minor importance; practically no commercial value.

FOREST TYPES AND SITES TO BE DISTINGUISHED
IN THE FOREST SURVEY OF THE DELTA

The Forest Survey to be made in the Delta, beginning in the spring of 1932, will include the recognition of broad forest types and sites. There is as yet comparatively little detailed or exact information concerning types in the Delta because there are few foresters thoroughly familiar with the region. The tentative cover types described in the previous section are naturally very far from being the last word, and like the various sites there are frequently intangible gradations from one to another. For these reasons not only will there be no attempt to distinguish all the tentative types given on pp. 33-54 but there will likewise be no attempt to distinguish all the sites listed on p. 4.

Only the following forest sites will be distinguished*: (1) bottom-land, (2) terrace (including second bottoms and higher bottoms), (3) swamp (anywhere), (4) river margin, (5) new batture land (outside the levee but otherwise similar to protected land). Ridges, flats and hummocky or washboardy lands under the primary forest sites, first bottoms and terraces, will not be distinguished because long familiarity with the region is necessary before one can recognize them quickly when following a compass line through the forest. In many cases, even a very experienced man would have difficulty in distinguishing certain sites.

The broad types to be distinguished*, and their relation to the tentative types already described, are as follows (the order is that given in the Survey Manual*):

*Field Manual for the Forest Survey in the Bottomland Hardwoods of the Mississippi Delta. G. H. Lentz, Southern Forest Experiment Station. January 12, 1932.

- (1) Cypress (tupelo). Includes both the southern cypress and the tupelo gum types, which are found on similar sites.
- (2) Cypress-hardwood. Practically the same as the southern cypress-hardwood type (the difference in name has no significance).
- (3) Cottonwood-willow. Includes the cottonwood and the willow types and will be used on almost all river margins.
- (4) Red gum. Includes the red gum, red gum-loamy ridge oaks and red gum-clay land oaks types, but the latter two only when red gum makes up 40 per cent or more by volume or 40 per cent or more of the dominant and codominant trees.
- (5) Overcup oak-pocan (water hickory). Identical with overcup oak-water hickory type.
- (6) Mixed hardwoods. Includes six types, oak-hickory, willow oak, willow oak-cherrybark oak-cow oak, hackberry-elm, oak-elm-ash and live oak, and also the red gum-clay land oaks and red gum-loamy ridge oaks types where red gum is exceeded by the oaks as a group. The live oak type will be the least commonly included and has generally the least significance of the six to eight types thrown together.
- (7) Pine-hardwood. Practically the same as the loblolly pine-hardwood type but broader.

With further reference to the mixed hardwoods type, several very real and significant differences are obscured by using this catch-all but

it will be very simple to apply and will presumably speed up the field work. In the office at the close of the Survey, this conglomerate type can of course be broken down, if desired, according to the primary sites and the forest conditions (virgin, cut-over, etc.). If finer divisions of site were recognized (ridge, flat and washboard) a rather complete breakdown could be made, but it was thought that the finer sites were as hard to recognize as the finer types. Under the circumstances, if the mixed hardwoods type is later broken down in the office it will probably be accomplished by means of key species for each finer type involved, with attention paid to the changes in a given type between first bottoms and terraces and between virgin timber and cut-over stands.

GENERAL UTILIZATION AND MANUFACTURE OF HARDWOODS

The bulk of hardwood stumpage is manufactured into lumber, but only a very small percentage of all the lumber produced at sawmills is ultimately used as such. The greater part of the output serves as raw material for factory and industrial uses and is remanufactured into special products which often bear no resemblance to lumber. In the softwood lumber industry about 80 per cent of the product, in its final form, is lumber and is ready to be used as such, but in the hardwood industry not over 15 per cent of the product is so used.

Standard hardwood lumber differs from softwood lumber in nearly all respects. It is cut into a much greater variety of thicknesses, viz., $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, $1\text{-}\frac{1}{4}$, $1\text{-}\frac{1}{2}$, 2, $2\text{-}\frac{1}{2}$, 3, and 4 inches; so thin at one extreme that it would almost be considered veneer in softwoods, and so thick at the other that it would fall in the category of cants or deals. There is no dimension lumber in hardwoods. In standard lumber of any thickness, width is disregarded but thickness must be technically accurate in the rough. It is cut random width rather than even or stock widths; no attention is paid even to cutting to the full inch and the edgerman merely works for the best compromise between volume and grade in each board--disregarding the exact width except as the highest grade is limited to a minimum width of 6 inches and all grades to 3 inches. Shorter lengths than in softwoods, as well as random lengths, are utilized and more attention is paid to grade, for the spread in money value from grade to grade is greater. Finally, the lumber is graded on an entirely different principle. Instead of grading a piece with a view to its general fitness for a certain class of structural work, it is graded on the basis of the percentage of its surface area that can be removed, by ripping and cross-cutting, in the form of a limited number

of absolutely perfect cuttings of a minimum size. The number, size and nature of the defects are not considered, but the amount of clear surface and the size and number of pieces that the clear surface will yield are of paramount importance. The highest grade of hardwood lumber has been the only exception to this principle, but a change in the grading rules that makes the principle apply also to this highest grade was made in 1931.

For the above reasons a higher minimum diameter is demanded in hardwood logs than in softwood logs and there are also differences in the type of log that can be utilized. Unsound defects and coarse sound defects, when local and few in number, are not nearly so serious as in softwoods, but numerous and closely interspersed defects, no matter how minute and sound, entirely disqualify a log for hardwood lumber whereas in softwoods they are but a minor degrade. Tie mills can use much of this sort of timber and, under certain circumstances, the softer-textured hardwoods of this type can be used for box and crate work, but these uses are possible only with negligible stumpage values and in comparison are not extensive.

It is of interest to note that hardwood lumber is not measured by a piece tally as in the case of softwood lumber. The board-foot surface measure of each piece is obtained directly with the standard board rule and is tallied by thickness and grade. The rule is laid across the board and the nearest figure to the edge of the board, in the column designated for the particular length under consideration, is the surface measure. For lumber one inch or less in thickness, surface measure is accepted, and for thick lumber the footage is obtained by multiplying the total tally by the thickness.

Cooperage material, crating and box shooks, veneer, ties, car stock, wagon stock and dimension material are also products of hardwood mills, but each makes up only a very small proportion of the total output of the hardwood industry.

Hardwood sawmills may be classified into a number of types based upon the products cut. The most important one, which accounts for more stumpage than all others combined, is the lumber mill. Owners of this type of mill own or control most of the timber land, employ the bulk of the skilled and experienced labor, and the mills are the most highly organized and the most heavily capitalized.

The general practice in lumber mills is to cut nothing but lumber for factory and industrial uses, with the exception of switch ties, timbers and planking, largely from the centers of oak logs (which material is most valuable in that form, can be sold green and requires no yarding). The lumber mill, however, is very versatile and is capable of cutting practically any hardwood product. There is, in fact, a present trend in this direction. For example, some mills manufacture squares for the simpler and more standard furniture parts and handle blanks, and in special cases produce standard finished parts on a large scale under contract. The automobile and furniture industries are the principal patrons of such special manufacture. This practice utilizes much material that would otherwise necessarily have to be handled and disposed of at a loss. Some of the larger and more highly-organized operators run supplementary plants for the manufacture of upper grade lumber into interior trim, moulding, etc., and some have worked their lower grades of oak into flooring. In some cases a box and crate operation is an outlet for the lower grades of lumber.

Notwithstanding this pronounced trend toward the manufacture of a finished product in the producing region and even at the mill, only a very small part of the hardwood output is now worked at the mill, and from the economic viewpoint much too small a part is worked up in the producing

region. The trend will undoubtedly continue until a more logical balance is reached.

Other types of hardwood sawmills are tie and car stock mills, wagon stock and special dimension mills, cooperage mills and veneer plants. The production of these mills is very small compared to that of lumber mills, but such plants are economically important and probably will become more so.

Many tie mills cut standard cross-ties exclusively, but some of them also cut switch ties, car stock, planking and structural dimension. In practice no two mills are exactly alike and most tie mills produce a little lumber just as most lumber mills produce some ties and dimension. The tie mill, however, is always portable or semi-portable and converts at least the major portion (if not all) of each log into ties and rough, heavy structural material. It operates in cut-over stands, in second growth, in small isolated tracts or in stands with much low-grade material, and cuts very largely on orders and contracts. The dimension material is not cut in standard sizes and carried in stock as in softwood lumber work, but is cut to size according to varying specifications for car construction, bridge and dock construction, etc., somewhat in the style of the softwood timber and heavy dimension mills. As a matter of fact, there were hardwood mills quite comparable to longleaf pine timber mills (but on a smaller scale) which cut large oak dimension and timbers in the days of wooden ships and extensive railroad expansion. The demand for such work, however, has fallen even lower than the supply of large timber than can economically be put to such uses, and now the exclusive production of structural stock is confined to the smaller mills which use rather small and rough timber and which rarely produce anything but cross-ties, switch ties, car stock and planking. All such material is sold by the thousand-foot board measure except cross-ties.

Wagon stock and special dimension mills have been a typical adjunct of the hardwood industry since its beginning, but as separate and distinct units they are fading in importance as fast as the tie mill is gaining. In the Central States, the Appalachians, Missouri and Arkansas much of the thriftiest and toughest oak and hickory was first exploited by mills that cut the timber primarily into wagon and vehicle stock. In many such mills only the very best part of the tree, suitable for wagon or buggy parts, was used. In others, some lumber and even ties and car stock were produced incidentally. There are still a few such mills but the widespread replacement of buggies and wagons by automobiles and trucks has greatly reduced the demand for such stock. The supply of timber suitable for economic conversion exclusively into products demanding the highest grades is likewise becoming scarce.

In connection with this phase of the industry there was formerly a supplemental type of small mill that used much fine second-growth ash and hickory, and incidentally persimmon and dogwood, for spoke and handle blanks, athletic goods and shuttle blocks. This material was often very wastefully split or rived by hand. The special dimension mill was the result of a gradual evolution and with further changes will probably survive, replacing both its recent form and the vehicle stock and furniture blank mills. There is a distinct tendency in small dimension work to develop the production of blank small furniture and even auto body parts and to utilize low-grade timber and mill waste in addition to high-grade special products. There is also a tendency to coordinate this sort of work with that of the general lumber operation and undoubtedly many benefits will result when proper coordination is worked out. The production of spoke blanks has become negligible but the growth in the production of athletic goods has to some extent taken

its place. All wagon stock and special dimension is cut to specification on orders or contracts.

Since the beginning of the industry, all cooperage material has been produced as a primary product (i.e., made directly from logs or bolts rather than from lumber) and moderate amounts of crating and box shooks have always been produced in this way, especially when rotary-cut box veneer is included. Other direct productions for specific use are those of paper pulp, and of veneer for furniture and paneling.

At present the trend is away from the large lumber-producing unit toward a smaller type, possibly even a semi-portable mill for some purposes. This seems to be the logical development as the large unbroken areas of high-grade timber are cut over and increasing reliance must be placed on smaller, scattered tracts and on second-growth or pickings from old cut-over areas. It seems probable that this trend will be accentuated when reliance is further placed entirely on second-growth and the product of managed stands. This type of mill can obtain logs more cheaply under such forest conditions and can more practicably be put on a sustained yield basis. At the same time, if given the expert management the big mill usually has, it will cut just as fine lumber at about as low a milling cost. The correlation of the work of the lumber mill and the tie mill will be important and possibly the distinction between the two will be lost. The supply of tie material will become proportionally greater as small young timber becomes the main source of supply. As the trend toward complete fabrication at the point of origin continues, however, there will develop a limit to the minimum efficient operating unit due to the complexity of the manufacture, and it will be essential for the smaller operations to handle their outputs through some form of concentrating, finishing, and marketing organization.

The great care and skill required in drying hardwood lumber and the necessity of building up a large and well-assorted stock which is turned over only about three times a year, plus the inherent high cost of high-class work in hardwood manufacture, make the fixed investment in a hardwood operation greater for any stated capacity than in any other branch of the lumber industry, with one exception. This is the cypress industry, where even slower drying is common though not entirely inherent. In point of technical and practical skill, and knowledge of lumber, the manufacture of hardwood lumber is more exacting than any other branch of the industry though in the matter of mechanical and administrative efficiency some of the best large-scale softwood operations are individually of a superior order.

If there is a continuing demand for forest products of the same quality and in the same quantity now produced, it seems that silvicultural practices must be adopted and that the lumber industry must be revamped along lines not only of closer and cheaper utilization, but also of more logical and economic utilization; that is, a utilization--starting in the woods--of the right material for the right purpose, which not only saves waste but raises the average net value of the output.

The old practice of working an entire forest into a single type of product and throwing away all the unadapted material is rapidly passing and must pass entirely before intensive silviculture can be an economic measure. In this connection, it is certain that ultimately all phases of utilization--lumber, ties, cooperage, small dimension, veneer, paper, etc., and even fuel--must be correlated. These various industries must at least be caused to draw upon the same forest units at one and the same time, if not to operate under a single business organization.

THE PRINCIPAL AND MOST COMMON SPECIES
AND GROUPS OF SPECIES FOUND IN THE DELTA BOTTOMLANDS

The species discussed in the following pages are selected partly on the basis of commercial importance and partly on the basis of abundance in the Delta.

Names in use in the Delta: Cypress, bald cypress, yellow cypress, red cypress, tidewater cypress (only in southern Louisiana). The last three are common trade names.

Distribution and habitat in the Delta: Found throughout the Delta but abundant to predominant, and occurring over large unbroken areas, only in southern Louisiana where it is now largely cut out. It was, and to some extent still is, the commonest species in the prevailing low wet flats, shallow bayous and deep swamps of that region. Northward, cypress is locally common in sloughs, swags, ox-bow lakes and swamps, on bayou banks, and mixed with hardwoods on flats. In the local wet sloughs, swags and swamps, cypress usually occurs in pure, dense, even-aged stands known as cypress brakes ("brake" refers primarily to the character of the stand but as cypress "brakes" occur almost wholly in wet depressions, the word seems almost synonymous with that class of site and is often loosely used to refer to the site rather than the stand).

The typical site has a rich, thoroughly moist to saturated soil that is frequently overflowed and more or less permanently submerged.

The slow-growing cypress that comes largely from the bayous and deep swamps of southern Louisiana is known to the trade as red cypress or tidewater cypress. The faster-growing cypress that comes largely from the local sloughs, swamps and brakes of the region from central Louisiana northward is known to the trade as yellow cypress. Frequently, however, there is no essential difference in the growth rates of red and yellow cypress.

Occurrence by forest types, and most common associates: Cypress occurs principally in the southern cypress type, next most commonly in the southern

cypress-hardwood type, and next in the tupelo gum type. Cypress is one of the most common and most typical species found in the Delta (or in the South as a whole) because in spite of its restriction to particular, localized sites it commonly takes over even the smallest units of such sites and is accordingly found in appropriate places in most of the other forest types in the Delta.

Virgin stands of the southern cypress type consist of practically pure cypress and the average stand per acre is much heavier than the average for Delta hardwoods. There are records of stands of about 1,500,000 board feet on a forty (40 acres) and of over 100,000 board feet on selected acres. However, stands of 8,000 to 10,000 board feet per acre over large areas are considered very good. Ordinarily cypress makes up 50 to 80 per cent of the stand when mixed with other species (southern cypress-hardwood type), and 85 to 98 per cent over extensive areas when in pure stands.

Tupelo gum, green ash (in Louisiana) and willow are the most common associates in pure stands of cypress. The first two occur principally in the understory and are often of very poor quality. Willow occurs chiefly in the openings (natural or created by cutting). Planer tree, red maple, swamp privet and overcup oak are also very common but are almost always very small, scrubby and present only in the understory.

In the southern cypress-hardwood type, a great variety of hardwoods occur: Nuttall oak, overcup oak, red gum, silver maple, red maple, white elm, green ash, etc. Locally, any one or more of these associates may be very common.

General appearance: Cypress is so widely known and so different from other trees that no description of any kind seems necessary here.

Economic considerations: Cypress has been one of the most important and outstanding species in the history of the lumber industry. It is in a class

SOUTHERN CYPRESS - Taxodium distichum (L.) Richard

with the white pine, white oak and longleaf pine of the past, and was comparable to the Douglas fir of the present. It was the basis of an industry in southern Louisiana before longleaf pine was cut other than locally, and at the same time that the white pine industry was first becoming well established in the Lake States.

It is still one of the outstanding commercial species but is rapidly losing in volume and prestige on the market because of the vanishing supply of virgin timber in the regions where it was cut as a special industry, and because of the competition of redwood. Cypress has long been the staple material in tank and ship-building, and to a smaller extent in bridge and dock work, both for sawn parts and for posts and piling. It has also long been a favorite cross-tie timber throughout the South. In addition to these special uses, cypress has been, and still is, extensively used for all common and general purposes, both in structural and in factory work. It is a staple material for retail yards in all items for general construction, and most mills cutting any considerable volume of cypress are equipped to ship finished stock direct to retail yards. On the other hand, it is very widely used in factory work for every purpose from flooring and finish to furniture, fixtures, coffins and laundry appliances (especially the latter).

Because of this dual type of utilization, which is far more marked than in any other species, the grading rules for cypress are based on both the principles of cutting percentages, as in hardwoods, and those of face defects, as in softwoods. The "shop" grades correspond to the hardwood "common" cutting grades and the "common" grades correspond to the softwood "common" grades for general carpentry.

As with hemlock in the North, forest conditions make it inevitable that great amounts of cypress should be exploited by hardwood mills which have been

instrumental in developing a different type of utilization than is common to any other softwood. The rules of the National Hardwood Lumber Association and the Southern Cypress Manufacturers' Association cover cypress fully in every particular. The latter organization long controlled the greater part of cypress production because it included the cypress producers in the exclusive cypress regions of southern Louisiana, southern Georgia and northern Florida. However, the major portion of the annual cut of cypress is now probably produced at hardwood mills, throughout the South but especially in Arkansas. The rules of the two associations have recently been made identical, but the exclusive cypress producers will largely continue to follow softwood customs and the hardwood producers will cater to factory trade.

Exploitation in the exclusive and specialized cypress industry is very close and complete in both woods and mill. The adaptability of cypress to common light structural purposes, like any softwood, leads to the cutting of all sound trees down to a small size, commonly to a ten-inch top; and the development of complementary shingle, lath and box plants makes possible the utilization of swollen butts, and nearly everything but the sawdust. The swamps of southern Louisiana are cut clean and in some cases even old snags are cut and down trees are worked up. Where cypress is cut incidentally to hardwood logging the diameter limit is small but the utilization of the trees cut can not be so close; excessively swollen butts, slabs and edgings are largely waste. Since cypress stands are usually even-aged, a close cutting for lumber in young stands practically eliminates the possibility of a good stand of mature timber developing from what is left. On the other hand, tie and pole cutting in the more accessible young stands leaves them in even worse condition. In some cases whole stands have been cut clear just for shingles.

SOUTHERN CYPRESS - Taxodium distichum (L.) Richard

Cypress is not damaged by any insect pest and by only one important fungus, which causes a heartrot (the incipient stage of which is "peck"). The only type of defect that is at all common is shake. Fire of course takes its usual toll, and fire scars dating back to 1893, 1911, 1916 and 1924 (bad fire years) can frequently be found in cypress stands.

THE HICKORIES AND PECANS - Hicoria Rafinesque

For the purpose of discussion, the Delta hickories and pecans are best divided into two groups that have but little in common. The first group includes two very common species:

(1) Pecan - Hicoria pecan (Marshall) Britton

(2) Water hickory - Hicoria aquatica (Michaux f.) Britton

A potential third member of this group is bitter pecan - Hicoria texana (LoConte) Britton, which probably occurs in the Delta but has not yet been reliably reported as far as known.

Pecan is the tree that yields the well-known edible "wild native" pecan nuts of commerce and is often cultivated in selected varieties; it is often called sweet pecan. Water hickory produces small, flattened, very bitter nuts and in the Delta is almost invariably called bitter pecan. The true bitter pecan (texana) closely resembles sweet pecan but has bitter nuts. The nuts of each of these three trees are covered with very thin, brittle husks (about 1/16-inch thick). Pecan and water hickory are both much more common in first than in second bottoms. In the forest, these two are often difficult to distinguish from one another in the absence of nuts. Their outward resemblance is well matched by the similar characteristics of the lumber produced from each. Lumbermen rarely cut either tree but when they do handle them no distinction is usually made between them and both, as "pecan", are considered distinctly inferior to other hickories.

The second group of Delta hickories probably includes at least the following:

(1) Bitternut hickory - Hicoria cordiformis (Wang.) Britton

(2) Nutmeg hickory - Hicoria myristicaeformis (Michaux f.)
Britton

- (3) Shagbark hickory - Hicoria ovata (Millor) Britton
- (4) Bigleaf shagbark hickory - Hicoria laciniosa (Michaux f.) Sarg.
- (5) Mockernut hickory - Hicoria alba (L.) Britton
- (6) Pignut hickory - Hicoria leiocarpa (Sarg.) Sudworth

The first two of these have nuts borne in very thin, brittle husks (about 1/16-inch or less thick) but the remainder have thick husks (at least 1/8-inch thick, usually much more). All seem to be more common on second bottoms or terraces than in first bottoms and they may therefore conveniently be called "terrace hickories" in contradistinction to pecan and water hickory. The wood of the different species is similar enough so that trade distinctions on the basis of species are very uncommon. They are generally cut merely as "hickory" and as a group their technical qualities are far superior to those of the "pecans". Many small operators and the statistics of lumber production, however, seldom make even that distinction.

The species of this second group of hickories, "terrace hickories", are usually difficult to separate from one another in the field, for which reason very little is known at present concerning the range, distribution, habitat and characteristics of the individual species. Under the heading "terrace hickories", below, these species are discussed to the fullest extent compatible with the present state of knowledge and the section is necessarily short.

PECAN - Hicoria pecan (Marshall) Britton

Names in use in the Delta: Pecan, sweet pecan.

Distribution and habitat in the Delta: Pecan ranges throughout the Delta but is much more common in first than in second bottoms. It occurs principally on ridges, especially front ridges. It is rare on low clay flats. On ridges, pecan usually occupies swags and drains. It appears to prefer moist but fairly well drained soils and although it is often found on sites occasionally overflowed, it is extremely rare on sites subject to frequent, deep overflows of long duration.

Occurrence by forest types, and common associates: Pecan is occasional to frequent in many types but is not often common. It occurs as single trees and small groups scattered through the stand in the red gum-loamy ridge oaks, red gum, cottonwood, hackberry-elm, red gum-clay land oaks and oak-elm-ash types. No particular species seems more closely associated than others, but common associates are red gum, water oak (Quercus nigra L.), American elm, hackberry, honey locust and persimmon.

General appearance: Pecan is a medium-sized to large tree with a tall, straight trunk and stout spreading or ascending branches. The branchlets are comparatively few in number, stout, stiff, coarse and ascending. The leaves are alternate and pinnately compound, large (12 to 20 inches long) and made up of 9 to 17 large leaflets. The fruit, which is widely known, is an ovoid or ellipsoidal brown nut, containing a sweet, oily seed or "meat" and borne in a very thin, brittle husk. The terminal buds are yellowish-gray, about one-half inch long, acute and tomentose; the lateral buds are smaller and ovoid. The bark is moderately thick (1 to 1½ inch), grayish-brown or brownish-gray, and usually broken into long, much-interlaced, narrow, rounded, scaly ridges. On

PECAN - Hicoria pecan (Marshall) Britton

many large trunks, however, the bark breaks into shaggy, much-interrupted, platy ridges.

Distinguishing characteristics: The fruit is absolutely distinctive and the habit, leaves, buds and bark can be confused only with water hickory, Hicoria aquatica (Michaux f.) Britton. The bark of pecan is usually grayer and at least on young or medium-sized trees more definitely, narrowly and closely ridged (rather than obscurely ridged or with loose, shaggy, platy ridges) than that of water hickory, and the habitat of pecan is much higher and better drained than that of water hickory. Nevertheless, in the absence of fruit the two are often difficult, if not impossible, to separate. It may be said that pecan is very rarely found on the most typical water hickory sites, but that water hickory is often found on typical pecan sites; it is in the latter case that most of the difficulties of identification are encountered.

Economic considerations: Pecan and water hickory. (These two are best discussed together. They are cut and sold as "pecan" and to distinguish them from the "terrace hickories", cut and sold as "hickory", both together are referred to below as "pecan". Hicoria pecan alone is referred to below as "sweet pecan"; "water hickory" of course refers entirely to Hicoria aquatica.)

Pecan is of only minor economic importance and until about 1917 was of practically no importance whatever. During the World War, pecan was often substituted for hickory and even occasionally for walnut when the suddenly enlarged demand for the latter species brought out many imitations and substitutes. Since that time the use of pecan has been maintained on about the same scale and a small amount is cut annually at numerous hardwood mills in the Delta.

As a substitute for walnut, and in furniture work, sweet pecan is preferred to water hickory and many mills state that their cut of pecan includes

no water hickory at all. Sweet pecan has a darker heart, less sapwood and a milder figure than water hickory and is said to dry with less degree. Compared with sweet pecan, water hickory has a redder heart and a yellower sapwood. Pecan as a whole is extremely hard and heavy for furniture wood and very brash for a member of the genus Hicoria. Sweet pecan is cut largely into 4/4, 5/4 and 6/4 stock and often only the #1 Common or better can be shipped, although furniture factories usually take the log-run grades (i.e., all the grades, just as they are sawn) and a few chair factories and small handle and novelty works will take the #2 Common alone. Very little sweet pecan is used in thick lumber for regular hickory purposes, but some 8/4 and thicker stock is cut for automobile body and small vehicle manufacture.

A small amount of water hickory is cut, like sweet pecan, into 4/4 and 5/4 stock for furniture. More commonly, however, it is cut into 6/4, 8/4 and occasionally 10/4 and 12/4 for light vehicle and auto body work. Unusually fine water hickory is sometimes cut directly into axles and other wagon stock by small wagon stock operators and shipped and accepted as "hickory". Both water hickory and sweet pecan have been used for baseball bats in recent years.

Pecan is not cut closely and frequently it is not cut at all; only large, clear straight logs can be profitably handled. Very few mills buy pecan logs on the open market and about 18-inch logs roughly selected for quality are usually the smallest taken by any operators. This light cutting, together with the usually good reproduction, insures the survival of pecan and possibly indicates an increase. Despite its slight commercial importance, the survival of water hickory is especially important because it is the principal natural species on extensive areas which for generations will be useless except for the production of rather low-grade hardwoods.

PECAN - Hicoria pecan (Marshall) Britton

The outstanding defect peculiar to pecan is wind and frost shake. In the northern part of the Delta, pecan is frequently so shaky over large areas that it is commercially worthless. Probably no other species except sycamore and honey locust have such bad shake. This defect is not so pronounced in the southern part of the Delta and along the Gulf Coast, which makes it appear likely that the shake is caused by frost.

In drying pecan lumber (and also hickory lumber proper) interior dote causes as much loss as in elm. Pecan has a relatively large area about the center of the log from which the wood is particularly subject to shake, checking and warping in seasoning. This accounts for the practise of cutting only large, straight logs. With the exceptions noted, however, pecan has fewer defects than hickory proper. It is more or less free of knots and bird peck in thrifty trees and it is not subject to any serious fungous disease. Two insects, a web worm and a leaf skeletonizer, occasionally cause damage. The former appears in late summer and most often attacks sweet pecan.

WATER HICKORY - Hicoria aquatica (Michaux f.) Britton

Names in use in the Delta: Bitter pecan (almost everywhere), pecan, water hickory. Where water hickory is in no danger of being confused with sweet pecan or where the distinction is unnecessary (as in most logging), it is generally called "pecan". Those who usually call it merely "pecan", however, call it "bitter pecan" whenever it is necessary to distinguish it from sweet pecan.

Distribution and habitat in the Delta: Water hickory ranges throughout the Delta but is most common in first bottoms where it is common to predominant on low, very poorly drained clay flats subject to frequent deep overflows of long duration. In second bottoms it is also found on low wet flats. It is locally frequent in swags and drains on ridges but is extremely rare on ridges proper except bayou and gully banks frequently and deeply flooded.

Occurrence by forest types, and common associates: Water hickory is most typical and most abundant in the overcup oak-water hickory type. It is occasional to very common in the hackberry-elm, oak-elm-ash, red gum-clay land oaks and southern cypress-hardwood types. Water hickory is usually more common in cut-over than in virgin stands, due to the fact that it is either very slightly cut or not cut at all and that it reproduces very well. The stands on cut-over, low clay flats are often locally predominated by the species. It is most closely associated with overcup oak, hackberry, water and honey locusts, Nuttall oak, American and cedar elms, green ash and hawthorn.

General appearance: Water hickory is a medium-sized or fairly large tree with a tall, straight trunk and slender to moderately stout ascending branches. The branchlets are not numerous and while relatively stout are not usually as

WATER HICKORY - Hicoria aquatica (Michaux f.) Britton

stout as in sweet pecan. The leaves are alternate and pinnately compound, large (9 to 16 inches long) and made up of 7 to 13 moderately large leaflets. The fruit is an absolutely distinctive, much-flattened, strongly ridged and angled nut, about 1 inch long and almost as wide, enclosed in a very thin brittle husk and containing a very bitter seed. The terminal buds are dark brown, about one-quarter inch long, acute and somewhat hairy. The bark is moderately thick ($\frac{1}{2}$ to $1\frac{1}{4}$ inch), grayish-brown, and broken into long, more or less loose, scaly-surfaced platy ridges; on large, old trunks it is shaggy. Mistletoe is probably more common in the crown of water hickory than on any other Delta species (and next most common on water oak, Quercus nigra L.).

Distinguishing characteristics: Water hickory can hardly be confused with any other tree except sweet pecan, from which in the absence of fruit it is often almost impossible to make positive distinction. As with sweet pecan the nut is the one best distinguishing characteristic. Other points of difference between the two are given above under pecan.

Economic considerations: See above under pecan, where sweet pecan and water hickory are discussed together.

"TERRACE" HICKORIES

These probably include at least the six hickories named above, i.e.,

(1) bitternut hickory - Hicoria cordiformis (Wang.) Britton; (2) nutmeg hickory - Hicoria myristicaeformis (Michaux f.) Britton; (3) shagbark hickory - Hicoria ovata (Miller) Britton; (4) bigleaf shagbark hickory - Hicoria laciniosa (Michaux f.) Sarg.; (5) mockernut hickory - Hicoria alba (L.) Britton; (6) pig-nut hickory - Hicoria leiodermis (Sarg.) Sudworth.

Of these, bitternut hickory is recognized by its thin, pale, very close, very shallowly ridged bark, its small (about 1 inch long) ovoid, gray or pale brown nuts borne in yellowish, very thin, brittle husks and its compressed, scurfy, bright yellow terminal buds borne on reddish-brown branchlets. It is apparently not common anywhere in the Delta bottomlands but has been most often found on loamy first and second bottom ridges.

Nutmeg hickory is best recognized by its gray-spotted dark brown, small (about 1 inch long), ellipsoidal nuts borne in very thin, brittle yellowish husks and its plump, ovoid terminal buds that are covered with yellowish-brown scurf and borne on slender golden or rusty yellow branchlets. It is apparently restricted in the Delta to southern Arkansas, where it is locally very common, principally on high second bottom flats.

Shagbark hickory is best recognized by its bark, which is gray and characteristically broken into long, wide, hard plates that are usually attached only at the middle. It has large (8 to 14-inch long) leaves with usually 5 leaflets; its long ($\frac{1}{2}$ to $\frac{3}{4}$ -inch) ovoid terminal buds with dark, triangular outer scales; and its oblong, thin-shelled nut borne in a large, thick husk (1 to $2\frac{1}{2}$ inches long and $\frac{1}{4}$ to $\frac{1}{2}$ -inch thick). The branchlets are pale reddish-brown and often glabrous. This species is apparently well distributed in the Delta and

is probably most frequent on second bottom ridges, especially in Arkansas.

Bigloaf shagbark hickory has extremely large (15 to 22-inch long) leaves, usually with 7 leaflets; an ellipsoidal thick-shelled nut borne in a large, thick husk ($1\frac{1}{2}$ to $2\frac{1}{2}$ inches long and $\frac{1}{4}$ to $1/3$ -inch thick); very large ($\frac{1}{2}$ to 1 inch long), ovoid terminal buds with dark, triangular outer scales; and thick, gray bark that breaks into long, broad, hard plates. The branchlets are pale orange and pubescent. Its range in the Delta is very imperfectly known, but it has been noted principally on first and second bottom ridges in Arkansas.

Mockernut hickory has a close dark gray bark broken into low, scaly, rounded, much-interlaced ridges; large ($\frac{1}{2}$ to $\frac{3}{4}$ -inch long), plump, broadly ovoid terminal buds borne on stout brown branchlets; moderately large (8 to 12-inch long) resinous and fragrant leaves with 5 to 7 leaflets; and ellipsoidal, pale brown nuts borne in large ($1\frac{1}{2}$ to 2-inch long), only moderately thick ($1/10$ to $3/8$ -inch) husk. Its range in the Delta is very imperfectly known and its identification has so often been doubtful that nothing further will be said except that it is probably most common in Arkansas.

Pignut hickory has fairly large (11 to 14-inch long) leaves, usually with 7 leaflets; long ($\frac{1}{2}$ -inch) acute terminal buds; ellipsoidal, pale reddish-gray nuts borne in rather large, fairly thick husks ($1\frac{1}{2}$ to 2-inch long and $1/6$ to $\frac{1}{4}$ -inch thick); and gray, tight bark broken into low, interlacing, scaly ridges. It is probably the most common "terrace" hickory south of central Arkansas in the Delta, but it is difficult to distinguish from other species, notably mockernut, and its range and occurrence are very imperfectly known.

The Delta "terrace" hickories apparently hybridize to a considerable extent and it is hard to find individuals in which all characters agree with those of any one species described in Sargent. The brief descriptions given

above are based less on field experience than on the authoritative descriptions of Sargent et al (especially as to measurements). Much more study will be necessary before the Delta hickories can be discussed at any great length.

Economic considerations of the hickories proper (as distinguished by lumbermen from "pecans", sweet pecan and water hickory): No tremendous volume of hickory, as of oak or gum, has ever been used at any given time but next to ash the hickories have probably been the most consistently used and sought-after species from earliest times; they have also been the most indispensable for several special purposes. However, unlike ash, hickory recently reached its peak of popularity and usefulness and seems now to be on the decline because of the substitution of other woods. This is due in some cases to the scarcity and cost of the timber but even more to the fact that the vehicle industry no longer uses it so widely.

In Louisiana, hickory has been of major importance though never of such very great importance as in the Ohio Valley, Kentucky, the mountains of Tennessee, or even Arkansas. Partly because of the approximate exhaustion of high-grade timber and partly because of the waning market, hickory in Louisiana is now of only secondary commercial importance.

Hickory was formerly used preeminently for wagon and carriage work since it is indisputably the best wood for all parts but wagon tongues, for which ash is the best. The wagon stock and buggy dimension work in the Central and Mountain Regions and northern Arkansas was formerly an industry in itself. Special handle manufacture ranked next as an outstanding use, followed by large furniture and fixture framing, ordinary furniture work, and any and all special parts requiring the greatest of strength, toughness and good working qualities.

Nearly all hickory that went through lumber mills was cut thick, principally for the wagon factories and repair shops. A larger quantity, however, was

cut to order in small special dimension mills or split and rived out by hand.

The development of the automobile has practically eliminated the carriage business and greatly curtailed wagon manufacture, especially of heavy high-grade types, and at the same time little hickory is used by the automobile industry. For many years a single item, spokes, nearly offset the loss in wagon stock consumption, but now that the vast majority of automobile wheels have wire spokes there is no compensating market. The Ford and Buick spoke market, at least in 1923, probably brought hickory to its peak in value. The growing scarcity, coupled with a fairly well sustained demand for spokes, kept the price of hickory unreasonably high for many years but at the present time the price is below red gum and oak and but little higher than black gum and similar species except on special orders or for logs for export. Not only has the automobile market been lost but most wagons are now made with oak parts. Most of the hickory now cut comes from lumber mills in the form of thick lumber for the purposes already mentioned.

Hickory is utilized very closely, although less closely than in former times. The old dimension industry, in working for spoke and handle blanks, frequently cut to an eight-inch limit in choice second-growth. At the present time the lumber mill will not ordinarily cut hickory much smaller than other species. For export the smallest size is usually twelve inches. As in the case of ash, local rather than commercial utilization is the serious menace to the future of hickory. Next to ash, hickory is the most popular fuel wood because it works up satisfactorily and possesses the greatest heat value per cord of any native wood. This often leads to ruthless butchery of young timber and together with its value for local handle-making and wagon repair has caused its virtual extermination, in a commercial sense, over considerable areas where the woodlots are otherwise in rather good condition.

This is the more unfortunate because it seems evident that the future supply must come largely from woodlots. Much of the present hickory supply is in woodlots and the proportion should increase in the future because the typical hickory site is almost always agricultural unless too steeply sloping, too limited in area, or too inaccessible.

The two most common defects of hickory are bird peck and small sap or adventitious knots. Many apparently splendid specimens are commercially almost worthless because of one or the other of these defects. Except for web worm in the late summer there appears to be no especial insect pest, and there is no serious fungous damage.

SOUTHERN COTTONWOOD - Populus deltoides virginiana (Castiglioni) Sudworth

Name in use in the Delta: Cottonwood.

Distribution and habitat in the Delta: Cottonwood occurs throughout the

Delta but is confined very largely to river margins and batture land, where it is usually very common or predominant on the higher, sandier sites, and to old fields and the banks of drainage ditches. It is occasional in openings in mixed hardwood stands on interior, usually sandy or loamy, ridges. Cottonwood is most typical on fresh, moist, recently-deposited, alluvial sands, silts and loams but will germinate and grow on almost any exposed alluvial soil that is not unusually dry, sour, impervious or subject to prolonged submersion by more or less stagnant standing water. Temporary, even deep, inundations are not harmful. It is very intolerant and probably requires more growing space than any other Delta species.

Occurrence by forest types, and common associates: Cottonwood is most

common in pure even-aged stands, i.e., in the cottonwood type, found principally on river margins and batture land. It is next most common in the red gum and the willow types. In the former, it occurs principally as single, dominant and usually very large trees. Old fields may seed in first with cottonwood and later with red gum, or with cottonwood and red gum at the same time; in either case, cottonwood by virtue of its faster growth takes a big lead and dominates the stand until many of the trees become too crowded and die. The tolerant red gum then becomes dominant and only occasional very large cottonwoods, that have made and preserved their own openings, remain in the stand. Fifty-fifty mixtures of cottonwood and willow are not common but either species is usually well represented in stands predominated by the other. As an occasional large dominant tree in mixed stands, cottonwood is most frequently found in the red gum-

SOUTHERN COTTONWOOD - Populus deltoides virginiana (Castig.) Sudw.

loamy ridge oaks and the southern cypress-hardwood types.

Common associates are: on river margins and batture land, willow and sycamore; on old fields, red gum, water oak (Quercus nigra L.), sycamore, American elm and white ash; in mixed stands on interior sites, the same as on old fields with the addition of southern cypress.

Stand per acre: Pure cottonwood stands are naturally very open and have relatively few stems per acre, but the growth is usually extremely, often phenomenally, rapid. Mature stands of large timber are usually from 35 to 60 years old and contain 4,000 to 12,000 board feet per acre. Older and larger trees of somewhat better quality are found on old fields and in the mixed stands, where cottonwood occurs only as single trees or in small groups.

General appearance: Cottonwood is widely recognized and hardly requires any description. It is one of the largest trees in the Delta, occasionally attaining a height of over 130 feet and a d.b.h. of 4 to 6 feet. The tall, massive gray trunk, with deep V-shaped fissures and prominent longitudinal ridges; the comparatively few, large, coarse branches and very pale branchlets, forming an open crown, silvery white in winter; and the large, coarsely-toothed, triangular leaves with flattened petioles are all very distinctive.

Distinguishing characteristics: Cottonwood can not be confused with any other Delta species except possibly swamp cottonwood, Populus heterophylla L. Swamp cottonwood, however, is very locally distributed and rarely common; it is confined to shallow swamps and sloughs, where cottonwood never occurs; and it has larger leaves, broadly heart-shaped instead of triangular and with round instead of flattened petioles.

Economic considerations: Cottonwood has never been a primary species of commerce but it has long been extensively used. It is an important staple in the hardwood trade and on the basis of stumpage value it is one of the more valuable species.

SOUTHERN COTTONWOOD - Populus deltoides virginiana (Castig.) Sudw.

The upper grades are used where wide clear surfaces are required for paint or enamel finish and as a base for veneers. In the middle grades it is used for cheap furniture, fixture and novelty work and for the backs and bottoms of drawers. In the lower grades it is used for box and crate work, for which it is especially liked. A special wagon box grade, more valuable than the highest standard grade, is commonly distinguished by mills that cut large volumes of cottonwood. It is the premier wood for this purpose because of its lightness, toughness and splendid painting qualities. Basswood and yellow poplar make equally good wagon box material but are less available. Sap gum and tupelo gum are also much used in this way but they are not preferred. Cottonwood is one of the leading soda pulp woods and a source of charcoal for special technical purposes. It is also used for slack cooperage.

Cottonwood is cut very closely in the Delta, often to a 10 or 12-inch top diameter, because it commonly cuts out a large proportion of high grades, because of the relatively high value of its low grades and because it is cheap to handle. Because it occurs for the most part either as scattered large individuals or in even-aged pure stands, it is commonly cut almost clear. A few trees in every stand are usually passed up by the loggers, however, and due to the prolific seeding and rapid growth of the species, its future is very bright.

Cottonwood is unusually free from damage by insects and fungi, although a leaf beetle occasionally causes considerable damage to young seedlings. It has no particular defect except the frequent development of a high proportion of knotty material, but this is confined to second-growth timber grown under rather unfavorable circumstances in open stands.

BLACK WILLOW - Salix nigra Marshall and variety
altissima Sargent, and other WILLOWS - Salix sp.

NOTE: The following applies principally to the common black willow and its variety, but other willows--less common, less readily identified, probably smaller and of very little importance individually--also occur in the Delta. They are not well known and no attempt is made to name or describe them. "Willow" is used below to designate principally black willow but also associated species of Salix.

Names in use in the Delta: Willow, black willow.

Distribution and habitat in the Delta: Willow occurs throughout the Delta on appropriate sites. It requires abundant moisture and much light; almost any soil is suitable. The genus is by far most common, and usually predominant, on river margins and batture land where it occupies the lower, wetter and usually less sandy sites. Willow is also common in swamps, sloughs and swags, and on the banks of bayous, gullies and drainage ditches, in short almost any place where moisture and light conditions are favorable. On local sites of this nature it occurs principally as single trees or in small groups or fringes.

Occurrence by forest types: Willow is naturally most common in the willow type, which includes all pure stands (usually even-aged) wherever found. The genus also occurs sparingly, in openings, in the southern cypress, tupelo gum and cottonwood types. It is often found in other types but only on small local sites. It is generally of highest quality in pure stands, and poorly formed and of low quality in stands dominated by other species.

General appearance: Black willow (Salix nigra Marshall and/or variety altissima Sargent) is a typical willow with alternate, long, narrow leaves that

BLACK WILLOW - Salix nigra Marshall

are acuminate at the tip. It frequently reaches a height of 120 to 130 feet and a d.b.h. of 2 to 3 feet. The bark is thick, dark brown and broken into long, narrow, flattened, rough plate-like ridges, shaggy on old trees.

Economic considerations: For many years, willow was more or less completely overlooked by hardwood operators, probably because in the regions of early hardwood exploitation it was both scarce and seldom of lumber size. However, of late years, especially since hardwood production in the Delta has been fully developed and the production of cypress has greatly decreased, the importance of willow has become recognized. It reaches its best development in the southern portion of the Delta where willow, tupelo gum and ash are about the only resource left the mills in the old cypress region. The bulk of willow timber (and the largest trees and best quality) is produced along the Mississippi River from Vicksburg south; smaller quantities come from the banks of the Black River (Louisiana), from the interior bayous south of the Red River such as Plaquemine and Gross Tete, and from similar places. The utilization is practically the same as for cottonwood (q.v.), even to charcoal, except that no willow wagon box boards are cut and willow is used more in natural finish in the upper grades because of its fine red, purple and brown shades. Selected willow is almost as good for natural finish as red gum but does not command an equivalent price.

THE OAKS - Quercus L.

General outline of the principal groups:

In the lower Mississippi River Valley, or Delta, there are many more tree species belonging to the genus Quercus L., the oaks, than to any other single genus of forest trees. There are more than 50 species of Quercus found in the United States and over 20 of these species occur in the Delta region.

There are two main groups of oaks generally recognized: the red oak or black oak group and the white oak group. Each group is popularly sub-divided further into two or three sub-groups. Following is a brief outline of these groups, with the names of the species in each group that are found in the Delta bottomlands. (Certain exceptions to the brief notes on each group are omitted unless involving a bottomland species. All species that occur in the bottomlands are probably not listed but all that at present are known or thought to occur are given.)

A. Red or Black oaks (Acorns maturing in two seasons; shell of nut usually pubescent inside; seed usually bitter; leaves or their lobes usually bristle-tipped.)

1. Red or black oaks proper (leaves deciduous in autumn to mid-winter and pinnately lobed, usually deeply).

Quercus palustris Muench. (pin oak) (a "water" oak to many lumbermen because of its site and technical properties)

Q. shumardii Buckley (Shumard red oak)

Q. nuttallii Palmer (Nuttall oak) (a "water" oak to many lumbermen because of its site and technical properties)

Q. velutina La Marek (black oak)

Q. rubra L. (southern red oak)

Q. rubra pagodaefolia (Elliott) Ashe (cherrybark oak)
("swamp red oak" in Sudworth)

Q. rubra leucophylla Ashe (cherrybark oak)
("swamp red oak" in Sudworth)

2. Water oaks (leaves tardily deciduous to nearly evergreen, and irregularly rhombic, wedge-shaped or three-lobed at the apex).

Quercus nigra L. (water oak)

Q. obtusa Ashe (water oak)

3. Willow oaks (leaves deciduous in autumn to mid-winter, entire or nearly so, linear to elliptical, and relatively small).

Quercus phellos L. (willow oak)

Q. laurifolia Michaux (laurel oak)

Q. imbricaria Michaux (shingle oak)

If only "red" oaks and "water" oaks are recognized, the "willow" oaks are included among the "water" oaks. If only "red" and "willow" oaks are recognized the "water" oaks are most frequently included among the "red" oaks. These subgroups are of popular rather than botanical significance and utility.

B. White oaks (Acorns maturing in one season; shell of nut usually glabrous inside; seed usually sweet; leaves or their lobes usually not bristle-tipped.)

1. Live oaks (leaves persistent through the winter and more or less completely evergreen; entire or practically so).

Quercus virginiana Miller (live oak)

2. White oaks proper (leaves deciduous and pinnately lobed, usually deeply).

Quercus alba L. (white or forked-leaf oak)

Q. stellata Wang. and variety and/or Q. mississippiensis Ashe

Q. macrocarpa Michaux (burr oak)

Q. lyrata Walter (overcup oak) (in a class by itself to most lumbermen and not called a white oak in the same sense as the others because of its low average quality)

3. Chestnut oaks (leaves deciduous and coarsely, sinuately toothed).

Quercus prinus L. (cow oak) ("swamp chestnut oak" in Sudworth)

Q. muehlenbergii Engelman (chinquapin oak)

The 19 species given above are by no means uniformly distributed throughout the Delta bottomlands. Similarly the habitats, associates, importance, etc. of these species are very different. The tabular outline affords a brief, ready comparison of such points (see pp. 19-22).

An elaboration of the information given in the outline, and a brief description and the distinguishing characteristics of each of the Delta oaks, are presented in the following pages, after discussions of the general economic importance and utilization of the entire genus and the typical defects and peculiarities.

GENERAL ECONOMIC IMPORTANCE AND UTILIZATION OF THE OAKS

Position in lumber industry

The oaks, because of their adaption to a great diversity of uses, their extensive range and their ample supply, comprise the most commercially important hardwood group in this country, and probably also in the world. They were extensively used both in fine furniture and in heavy, durable construction long before the settlement of this country, so that the early use of the abundant supply of native oaks was natural. Until the last two decades they had no rivals among the hardwoods with respect to the total volume used and but few rivals in many specific uses in interior finish, furniture, and flooring. For purposes of heavy construction they compared favorably with the softwoods with respect both to total volume used and to quality.

Yellow poplar, hard maple, birch, walnut, cherry and mahogany, prior to about 1910, were probably the only hardwoods that could ever be compared to oak, with respect either to volume or to general popularity. The first three of these species gained and held such a comparable position on the basis of volume and general utility for interior work, while the other species occasionally rivalled oak in popularity for furniture and cabinet work. However, oak was without a strong competitor in the hardwood field, from the very beginning of our history, in either the field of general utility or that of volume consumption until the phenomenal rise in the popularity and utility of red gum. In the past fifteen years red gum has supplanted oak in many of its old strongholds of products for interior use much more effectively than yellow poplar, birch, or maple ever did because it not only has most of the desirable qualities of these woods but there is also a large supply, second only to that of all the oaks combined and even greater than these in the southern part of the Delta.

With the exception of flooring, oak now ranks second in interior utilization, and both walnut and mahogany have gained in consumption and popularity, still further restricting the use of oak in furniture and cabinet work.

If it were not for the great expansion in the use of oak flooring during the past ten to fifteen years, oak would by this time have lost its traditional predominance over other commercial hardwoods and its stumpage value would have been ruined. However, its dominance in the flooring trade to an appreciable extent offsets its loss to red gum in interior trim and furniture, and its continued leadership in the field of hardwood construction material is unimpaired. In this last field, however, due to a gradual lowering of quality and sizes, it is now losing some volume to the softwoods. Although it has not yet occurred extensively, the development of treating processes for red gum threatens to cut sharply into the consumption of oak for these purposes also.

Despite these inroads, and the fact that in the Delta the production of red gum is equal to if not greater than that of oak, it is likely that because of its wider uses and the much greater range over which it is the dominant species, oak may be expected to maintain its predominance even when the supply is dependent upon the practice of silviculture.

Two groups of oaks

Naturally, the oaks are not all equally useful or important because the properties of each species are not the same and the supply of each species is not the same. In discussing the oaks as a whole, it will be necessary to distinguish only the main classes or groups. The white oak and red oak groups (see p. 19 et seq.) are recognized in the trade as entirely distinctive. Forty years ago red oak was of little value and only slightly used, while white oak was very valuable and the most widely used hardwood. This was because of the greater adaptability of white oak for heavy construction, railroad and ship building, and tight

cooperage. It was naturally the better wood for such purposes and the lack of preservative treatments often made its use absolutely necessary. Again, for a long period the styles of furniture were based on the use of white oak in the higher classes. In the early stages of hardwood exploitation, before extensive agricultural development, white oak was also more readily available in those regions which were most rapidly settled, since it habitually grows on the higher, drier, and more accessible sites. This feature has of course worked directly against its availability and use in more recent times.

For nearly a generation now, however, there has been little commercial difference in the value of the two classes of oak due to the scarcity of high-class white oak and to changes in the uses of oak itself, which are now more favorable to red oak than to white oak. The use of other hardwoods in the furniture trade in preference to white oak, and the increasing practicability of logging wet river bottoms and practicing close utilization with all species, have set red and white oaks more nearly at a common value. Any difference in volume consumption between the two groups at present is probably in the favor of red oak, but is due more to greater availability than to preference.

In each group of oaks there is a sub-group commonly thought of as "water" oaks (named from their occurrence on low, moist or wet sites), which is not definitely segregated in the hardwood trade but which is sufficiently different to warrant notice in a consideration of the oaks from a commercial viewpoint. There is one species of water oak in the white oak group and six in the red oak group*. In each class the technical characteristics are different and in some respects the quality is poorer than in the main group. Until the recent

*The species included under the term water oaks as used here and throughout the section are: Quercus nuttallii, Quercus palustris, Quercus nigra, Quercus obtusa, Quercus phellos, Quercus imbricaria (all red oaks) and Quercus lyrata (one of the white oak group).

extensive exploitation of red gum, with which the water oaks are commonly associated, little logging was done in sections running strongly to water oaks and when encountered they were largely culled over for such individuals as fitted in with the current purposes and otherwise left uncut as of little or no value. However, changes in utilization and general economic conditions have brought this group of oaks into general use with no great distinction from the main group, but it must be recognized and understood that the average quality of the water oaks is usually inferior to that of the red and white oaks proper.

Principal uses

The primary products into which oak timber is cut are, in an approximate order of importance: lumber; ties and structural materials, including car stock; tight cooperage; wagon stock; veneers; and small furniture and special dimension stock. The uses of oak extend into practically every field of utilization to which any hardwood is ever subject except the fields of paper and chemicals. In the past oak has been burned extensively for charcoal, and although seldom cut expressly for box and crate purposes it does reach into that field through the primary stage of low-grade lumber.

Lumber

Lumber probably accounts for considerably more oak stumpage than all other uses combined, although lumber is not an end in itself but stands for a multitude of uses too numerous to mention except by classes. The principal uses of oak lumber are for flooring, sash and door and interior trim work, and all types of furniture and fixture work. In addition, oak lumber enters to some extent into every form of novelty, handle, and toy work, vehicle and auto body work, and many miscellaneous articles. Some very low grade oak lumber is occasionally used as foundry crating and for grain car doors..

In the lumber trade there is no pronounced preference for either white or red oak; some purposes, styles and designs call for one, some for the other, and for many purposes the two can be mixed. However, there is some distinction between water oaks and the others in both the red and white oak groups. Most consumers do not discriminate sharply, but for some furniture and cabinet purposes soft texture and straight grain are demanded, and these properties are usually found in the red and white oaks proper and not in the water oaks, although the slow rate of growth frequently has as much to do with the soft texture as does the species. Upland and northern timber is most uniformly characterized by soft texture and Wisconsin, Indiana, and eastern mountain stock is usually given preference by the furniture and cabinet trade. On the other hand, the flooring trade appreciates a firm to hard and glassy texture and as this is more or less a characteristic of water oaks they are well liked in that trade, other things being equal. Since firm texture is generally correlated with rapid growth, Delta stock is quite favored by the flooring industry.

The standard or most staple thickness for oak lumber is 4/4 in all grades. Not only does the greatest single oak-using industry, flooring, use nearly all 4/4, but it is the essential item for most other types of consumption; 5/4, 6/4 and 8/4 are used to some extent in upper grades for stepping, furniture and fixture work, and the 5/4 also in some classes of finish and the 6/4 and 8/4 in sash and door work. A very little high grade 12/4 and 13/4 is cut from time to time for special work and for wagon shops and mostly distributed through retail hardwood yards in cities; 3/8, 5/8 and 3/4 stock is also cut, especially the latter two. As a general thing this thin stock is used in this country in the upper standard grades for paneling and special cabinet and furniture work, but for export it is used quite extensively for coffin and casket manufacture and is sold as a special grade, taking wide stock which may be defective but must have a perfectly sound face. A somewhat similar but lower and cheaper standard grade,

sound wormy, is used in this country for the same purpose in both thin and 4/4 stock.

The profitable cutting of lumber calls for a higher average grade of logs than any type of utilization except furniture and panel veneer and the best classes of tight cooperage. Unless the operation is doing a considerable amount of refining of its own product, such as working finish and flooring or cutting small dimension (which under present conditions can be done only by the largest and best-financed mills), an operation cutting only for lumber for the general market is forced either to handle small or low-grade logs at a loss or leave them in the woods, which is often done on a large scale. In case the logging is done with a minimum of damage to the timber that is left and protection from fire is afforded, this necessary leaving of small and rough timber, if sound, is a good rather than an evil economic condition and it is to be regretted that more operators do not know definitely the limit of profitable utilization for lumber. It is certain that a majority of operators overstep this limit. About 16 inches at the small end of the log is probably the smallest size that will yield a profit to the average operator, who markets only rough lumber and supplementary railroad stock. Logs of this size should be essentially clear butt or second cuts only. Many operators are cutting much timber as small as 13 or 14 inches at the small end (and rough timber at that) because of a feeling that the stumpage is too valuable to leave.

The real loss of material in the woods, in connection with exploitation for lumber only, comes from the cutting of great numbers of trees that are only partly usable for lumber and the balance of which are largely left to rot when not sent through the mill at a loss as described above. Many individual large trees, which either grew in the open or were released just after attaining their full height, are too rough above the butt log or above the first two logs to be used for lumber. Likewise, many stands of second-growth timber are good enough

for the first 14 to 32 or 36 feet to tempt the lumberman to cut them, yet too small or rough, or both, at the upper half or two-thirds of the sound bole to justify logging. Vast amounts of material of these two types are left to rot because, though wholly suited to tie, car stock, planking and bridge timber purposes, it does not pay to run such logs through a lumber mill, and the operators almost never have the capital or the energy to develop a supplementary business. These conditions have been described with particular reference to the oaks but they apply with but slight changes to almost all hardwood species.

Ties, car stock and heavy construction

The use of oak for ties, car stock, and heavy construction is very important and extensive. While as a whole it does not equal the use for lumber, in regions where no virgin timber remains it is the principal form of utilization. In the hands of business-like and efficient operators this type of utilization is not necessarily wasteful of material. However, at the present time a majority of such operations are wasteful due to poor management and lack of a wide variety of items on the cutting schedules. As usually conducted they are also wasteful of quality. While the lumber mill utterly wastes the upper portions of the small trees, the tie mill cuts the high-grade butt logs into the same low-grade material as the upper logs. The tie mill uses more actual volume in small timber but usually gets very little more in actual value. Taking ties alone also leads to clear cutting in the very type of timber where it is least desirable. There is a very evident need for coordination between tie operations and lumbering.

At first the white oak group was the only one used at all for these purposes, but later both groups of oaks were used, with, however, the white oaks in greater favor. Recently preservative treatment was become so common and cheap that more red than white oaks are used and stumpage prices are not

often different. Both red and white water oaks were long neglected for such purposes because of their greater tendency to check and split, which is unusually prominent in pieces of large size. This has now been largely overcome by careful manufacture and handling and at present little distinction is made in the northern half of the Delta region. In the southeast and in the southern half of the Delta there is still considerable discrimination.

While great volumes of switch ties, planking and timbers are produced at lumber mills, much of the supply of these items comes from separate operations and the major part of the supply of cross-ties, posts, poles, piling, and mine props comes not only from independent operations but from sections where there are no lumber operations at all. As a matter of fact, these items are typically products of cut-over regions, second-growth areas that are too small or too poor to lumber, and wood lots, and the producers are typically small free-lance outfits marketing through jobbers. Production occurs on every scale, from a single man with a broad ax to companies operating numbers of portable mills, and the industry is one of the principal reasons for many cut-over regions reverting to brush and many wood lots to "pasture". These operations not only commonly leave the forest in an unproductive state, but they are likely to be conducted along very crude, wasteful lines. As a general rule there is very heavy and frequently repeated overcutting.

Car stock is cut by both lumber mills and tie operations as "bill stock on order" and is complementary to the cutting of ties, planks and timbers because of the smaller and more varied sizes that can be used. However, this type of business has not been sought out to the extent justified by its value because the cutting of dimension bill stock requires such a departure from the established routine of the usual hardwood operation. For that matter, the production of heavy construction material has been unduly neglected by the hardwood industry, especially by the large and competent operators who could have handled business with

profit. The industry has let great volumes of this class of business pass to the longleaf pine and Douglas fir operators merely because it has not fitted in conveniently with the traditional methods and customs of manufacture and marketing.

Only the lumber branch of the industry has been well enough financed and organized to promote this class of trade on a proper basis and it, perhaps excusably under prevailing conditions, has considered this work of very minor importance. This was natural and to some extent unavoidable when stumpage was cheap and there was abundant timber of lumber quality. However, under the conditions created in the past few years, (and which will undoubtedly be accentuated during the next few years), it will be absolutely necessary in the interests of the industry--to say nothing of close and economic utilization--to operate not for just one but for several classes of products the requirements of which as to size and quality are complementary, i.e., different enough so that but little material need be wasted or forced into an uneconomic use considering its inherent properties.

Inasmuch as diameters down to 10 inches and lengths as low as 8 feet can consistently be used (and in sections where mine ties, props, posts and piling can be marketed to advantage much smaller sizes are useful), and since almost any kind or number of sound defects, and a few small unsound defects, can be admitted as long as they do not materially affect the strength, the complementary nature of the utilization of lumber and structural material is quite evident. These qualities and sizes overlap not only in the timber stand as a whole but also in the individual trees, inasmuch as most lumber trees contain top logs suitable only for structural material and the lumber-grade logs are of structural quality at the heart (unless unsound). On the other hand many trees contain a butt log of lumber grade and second or higher logs with high-grade side lumber. Any efficient or even profitable exploitation

of small low-grade or second-growth hardwood calls for a coordination of those two types of utilization.

What has been said regarding the cutting of structural material from oak also applies to other species adaptable to that use, and, because of the wide use of preservatives, most species of hardwoods are now used for that purpose. Red gum, especially second-growth, is an outstanding example.

Cooperage

The use of oak for cooperage, especially tight stock, dates back a very long time. Until recent years the white oaks made up almost the entire supply of tight stave material, but now that staves are paraffined and otherwise treated to close the pores red oaks and several similar woods have come into very extensive use, especially for heading. However, the white oaks still have the greater stumpage value. Until comparatively recent times cooperage work was done on a small scale by hand. The stave men usually preceded the lumber industry into each new region, culled over the best of the white oak stands and exploited them in a most wasteful manner. They cut every tree of good appearance and then used only such parts as were perfectly clear and straight-grained, often leaving a whole tree to rot if it was slightly cross-grained and difficult to split, and regularly using only 10 to 30 feet of the stem.

Because of this system it is almost impossible, in any section of the country, to find any extensive body of truly virgin white oak. The badly depleted supply of high-quality white oak timber is one reason for the elevation of red oak (which in many regions was never cut at all until the big lumber operators came in) to a comparable position with respect to most products.

The final near-exhaustion, throughout the country, of the choicest white oak not only forced the cooperage industry to the use of paraffined staves for

tight containers, but also to the use of machinery for the working up of a different class of bolts. While tight staves must be entirely free of both sound and unsound defects, they can be cut from short bolts and with machinery to do the work the bolts may very well come from short boles, crooked trees, clear sections between large limbs, etc. In this way cooperage may become complementary to lumber production if the lumber utilization is not too close, and to the production of structural and tie material. On the whole, the tight stave business in the aggregate is not very large and very possibly is on the decline. Some special types of staves are still split or rived from woodlot timber.

Veneers

Oak is used quite extensively as veneer for furniture and panel purposes. A small quantity of oak is used as veneer for crates and shipping cases, but it is generally avoided for this purpose because of its weight and because of difficulties in drying. Likewise, in the manufacture of high-grade veneers, Delta oaks are not greatly used because of their greater hardness and tendency to check. Some furniture and panel veneer is made in the Delta from selected oak timber, but the majority of such stock is turned and sliced from Central States and mountain timber.

While this work calls for the highest quality and the largest logs of any form of utilization, cutting veneer logs seldom butchers a stand as did the stave industry because ordinarily only the very finest logs from lumber operations or carefully selected from woodlots are taken. Use for veneer deserves recognition as a means of attaining a somewhat better return on selected logs of the best size and quality, but it does not seem probable that it will have any fundamental bearing on woods practice or industrial organization before such time as it may become feasible to raise large timber under

management. As with lumber, there is no distinct preference for either red or white oaks, though possibly more panel work is done in white oak.

Wagon and vehicle stock

The cutting of wagon stock requires good-sized straight logs of at least the quality of number two lumber mill logs. However, small sound defects can probably be treated slightly more leniently while unsound defects of any type must be more severely restricted. Formerly much fine oak, hickory and ash timber was cut rather ruthlessly for wagon and vehicle stock alone and, although usually of a heavy portable type, some of the operations were of considerable size and permanence. In many cases, long and heavy slabs, etc. were thrown away in sizing the cents. The hearts also were discarded after the material of wagon stock quality was cut away, for it would have been necessary to handle the side material as lumber and the hearts as car stock, plank, or switch ties. As long as timber was cheap many operators would not bother to learn a new game, although some operators did save either lumber or ties or both in a rather half-hearted, inefficient manner.

At present the cutting of wagon stock is almost wholly of secondary importance and is done mostly in conjunction with tie and car stock jobs, where there is a certain amount of timber too good to be cut into ties. More good timber is usually saved by such operations for wagon stock than for lumber. Wagon stock requires less care and technique in manufacture and grading than does lumber and can be sold green. Most wagon stock that is not gathered by jobbers from such small operations is remanufactured from thick lumber as already noted. While few lumber mills cut wagon stock, because the odd sizes interfere with their routine and the lumber grade is lowered by using the high-grade material in that way, there may still be a few large mills that cut their oak primarily into wagon stock.

Wagon stock is cut on order to specified rough green sizes for axles, reaches, tongues, bolsters, sand boards, etc., and though strength is the

essential property, the upper grade is substantially clear, allowing only one or two dispersed small sound knots, pin worm holes or bird pecks, and a little sound stain to each piece. There are only two grades, and very little of the second grade is sold since it is designed primarily to accommodate the off-grade material that is bound to accumulate in cutting for the first grade. Wagon stock, veneers and structural materials, as well as lumber, are graded under rules provided by the National Hardwood Lumber Association. Little change in the relative position of the wagon stock business is needed but vast improvement in detail is as necessary as in the tie business. It should continue in its important complementary relationship to the tie business in the conservation of quality material.

Special dimension

Much special vehicle and handle stock, spokes, felloes and hub stock, etc., has always been produced in conjunction with wagon stock. Until recent times much of this was split or rived out of choice timber, as in the case of tight cooperage. Now, however, the work is done entirely by machinery and most of what can not be produced along with wagon stock at the little tie mills is cut at special dimension mills which buy choice short logs and bolts of oak, ash, hickory, persimmon, etc., from the countryside for the manufacture of special items for vehicle work, athletic goods, shuttle blocks, etc. This latter class of mill can use much material that occurs in small quantities in the woods and a single mill frequently takes all the incidental products of the woodlots and large logging jobs in an entire region. Great quantities of persimmon, dogwood, ash, hickory and clear tough second-growth oak are, however, left uncut on many lumber operations while other stands of these species are badly over-cut, because of lack of liaison and cooperation between the two branches of the industry. The special dimension mills are nearly always located at points of concentration on railroads and buy material delivered to them. They almost never exploit an extensive stand of timber themselves but occasionally

a small pure second-growth stand receives their exclusive attention. Only clear high-grade material can be used, but since it can be used in short and small pieces many trees useless to either the lumberman or the tie-operator can be partially used under favorable circumstances.

The outstanding development in dimension work has been the production of blank standard furniture and auto body parts at lumber mills from low-grade lumber, slabs and edgings. Previously, these blanks were always ripped from lumber at the factory. Many small sawmills are now cutting rough squares for furniture and implement work in this way and the practice has gone so far that some large mills and several especially built and strategically located dimension or cut-up plants are making the finished parts ready for use. The latter especially applies to automobile body parts. The unfinished parts are cut to an almost equal extent for furniture and automobile use, and slightly for other vehicle and implement work. Oak and red gum are the outstanding woods for these uses but hickory, ash, elm and magnolia are also important. The greater part of the finished product is used in grades that require perfection. However, there are three grades in most of the items and the lowest one is merely a sound grade that will stand screws and nails and some strain. Sufficient amounts of the lower grades can be sold to enable use of most of the material that develops in cutting for the upper grade.

This work not only saves the freight and handling on a large volume of inevitable waste, but, by so doing, lowers the quality of lumber needed for the economical cutting of any given article and raises the amount of low-grade lumber that can economically be produced. In this way the woods practice and utilization are affected. As already stated, the product of this work must be, to a great extent, practically perfect, although due to its small size and the saving in cutting up at the point of origin as compared to the still common practice of shipping to destination for cutting up, it is possible to work

material giving a much lower yield than is feasible under old practices--to say nothing of the possibility of working up heavy slabs, edgings, etc. This work is attracting consideration to the possibility of utilizing short logs, crooked cuts, etc., in the form of bolts in connection with a regular lumber operation. In one case at least, a small operation is being run entirely on such timber left in the woods after logging for lumber. The logical development, however, will more likely be the utilization of such material by the lumber company, together with low-grade lumber and mill waste. Between this utilization of low-grade lumber and the increasing production at the mill of moulding and trim from upper grades and flooring from middle and lower grades, it seems likely that eventually only a small part of the product of the hardwood mills will be shipped in the form of lumber. Oak in particular is probably worked into furniture dimension more than into any other stock. It is also used to some extent for both vehicle and auto body parts. In the form of low-grade lumber, it is not used as much in this work as red gum because most of it goes into flooring, but there is much mill and woods waste adaptable to vehicle and auto body use. The special dimension phase of the industry is not yet fully developed and there is still much discussion of its merits. It seems, however, that it will be only a matter of time before it becomes an important part of the industry.

In all wagon stock and dimension work red and white oaks are used more or less indiscriminately, with some slight preference for white oak. The two groups are seldom separated.

Ship-building material

In nearly all popular notes on utilization, unmerited emphasis is laid on ship-building in connection with several of the important timber species. It may be well to say that the oaks have been one of the most important species

used in this way but that except in the earliest times ship-building material has not constituted one of the primary or direct products. Some ship material corresponds closely to bridge and dock timbers, some to car stock and heavy planking, and some is worked from lumber. A relatively great amount is produced under contract by large lumber mills. In the days of wooden ships many heavy timbers were hewn and there were once heavy-timber mills cutting oak ship, bridge and dock stock, but little of either type of work is done now. White oaks have been and still are the favorites and sometimes even the only ones used, but treating is to some extent changing this condition.

DEFECTS AND PECULIARITIES TYPICAL OF THE OAKS

The most general defect common to the oaks is the one most common to other species; that is, red or yellow heart rot of the butt and trunk, generally introduced by fire. It can hardly be said, however, that any one species of oak is consistently more susceptible than another. Grub holes constitute another very common defect, more commonly found in the group of water oaks* at the one extreme, and in oaks growing on too high or very dry sites at the other. It is difficult to say whether the occurrence of grubs is directly related to fire injury or merely to the stagnating effect of growing on either a too wet, heavy soil or a too dry, light one. Inferior specimens of almost any species of oak are prone to be grubby.

Pin knots constitute still another defect common to inferior individuals of any species but to upland post oak and the water oak in particular. This peculiarity is of course largely related to tolerance and growth habit, but all oaks seem prone to develop sap limbs when released too completely while still young. On the other hand, some of the water oaks seem to have the greatest number of persistent small limbs when growing on their poorest sites.

Shake is more or less prevalent among the oaks but it is not as conspicuous as in some other hardwoods. Overcup oak is undoubtedly the worst in this respect but there are really no other species outstanding in this respect. Blue (or green or black) mineral stain is another typical defect of oak, usually occurring in streaks but sometimes solidly coloring the heartwood of living trees. It occurs most prominently in the water oaks* but is likely to occur in any of the red oak group. Oak, except overcup and post oaks, is not particularly affected with bird peck or spot worms. It need hardly be mentioned that the oaks are among the hardest and heaviest of American woods. They are very likely to check in seasoning and they are among the most difficult

*See footnote to page 94 for the oaks included in this group.

woods to kiln-dry. However, there is a great variation in these respects; the water oaks are the hardest and the most difficult to dry. Even within a single species there is great variation, depending largely on site. Timber from ridges and dry, light soils is consistently softer than that from moist clay soils, and old original timber is softer than second growth. Soft stock is easier to dry than hard stock.

There is also considerable variation in workability, straightness of grain and cleavability. The advantage is with the better red oaks in this respect and the water oaks are the worst, having a tendency to twisted or interlocking grain. For oaks in general, however, the working qualities are good to excellent and the grain is straight and decidedly cleavable. Oak, as a whole, is not prone to warp greatly but individual water oaks give serious trouble and sappy boards are especially troublesome. Overcup oak is no doubt the worst in this respect.

PIN OAK - Quercus palustris Muenchhausen

Names in use in the Delta: Pin oak, red oak, tight-barked red oak, yellow-butt oak(?).

Distribution and habitat in the Delta: Found only from southern Arkansas and probably central Mississippi, northward. In this section of the Delta, however, pin oak is a very common tree, becoming more common as one proceeds north. In the northern part of the Delta it is probably more common than Nuttall oak, with which it is often associated. Pin oak typically occupies the same sites as Nuttall oak--i.e., low, poorly-drained clay flats (where fall and winter rains collect and remain in more or less continuous pools during the winter) and low clay ridges. It is also found on low, poorly-drained loamy flats, on the edges of swamps, and occasionally on very moist upland sites.

Forest types in which most commonly found, and most common-associates:

Pin oak does not seem to be most common in any one type but is occasional to very common in a number of types. These include the red gum-clay land oaks, southern cypress-hardwood, oak-elm-ash, hackberry-elm, overcup oak-water hickory, willow oak and willow oak-cherrybark oak-cow oak types. Strangely enough it also occurs in the oak-hickory type on moist loamy flats in second bottoms in Arkansas.

General appearance: Pin oak is a tree of moderate size (rarely over 85 to 95 feet high) and typically has a straight trunk, generally clear for but a short distance, and a symmetrical, pyramidal crown. In large trees the crown loses its original shape and becomes broad and rather open. The lowermost branches typically droop and usually remain on the tree long after their death. The slender branches usually bear a great number of short, spur or pin-like branchlets; hence the common name. The bark is light to dark grayish-brown, very hard, close, thin, and divided by narrow, shallow fissures into broad, low, scaly ridges. The leaves are thin, firm, dark green and lustrous above, paler beneath, and perfectly smooth except for tufts of pale hairs in the axils

PIN OAK - Quercus palustris Muench.

of the larger veins. They are deeply 5 to 9-lobed, moderately large (4 to 8 inches long by 2 to 5 inches wide), and have slender petioles, $\frac{1}{2}$ to 2 inches long. The lobes, separated by wide, deep sinuses, are irregularly toothed and generally much tapered to narrow, pointed ends. They are supplied with bristle-tips the number of which averages from 10 to 25 per leaf.

Distinguishing characteristics: Pin oak, by virtue of its habitat, form, bark and leaves, can always be separated easily from other bottomland oaks with the single exception of Nuttall oak (Quercus nuttallii Palmer). The distinctions between these two species are taken up in detail in the section devoted to Nuttall oak.

Economic considerations: Pin oak is not of great commercial importance but is sufficiently plentiful and useful to be cut wherever it is found in ordinary logging operations. Its most objectionable characteristic is its numerous small adherent limbs which cause excessively knotty logs. It is also a very heavy and hard wood that checks badly in drying. For these reasons usually only the best trees are cut in logging for lumber, but even then a high proportion of the lumber goes into the small cutting and lower grade uses such as flooring, small fixtures, handles, etc. Notwithstanding the presence of pin knots and the tendency to check badly, the typical form of the pin oak bole, coupled with its hardness, makes it a splendid structural timber provided too-coarse knots are avoided. It is therefore extensively used for ties, car stock, piling and general railroad material.

Pin oak does not appear to be particularly susceptible to injury by disease or insects but fire appears to cause unusually great damage. Shake is rather prevalent.

SHUMARD RED OAK - Quercus shumardii Buckley

Names in use in the Delta: Red oak (not ordinarily distinguished from other red oaks and never called Shumard red oak except by botanists and foresters).

Distribution and habitat in the Delta: Distributed throughout the Delta but apparently not common anywhere. Most frequent and largely confined to washboardy or hummocky sites in either first or second bottoms, but occasional on rich loamy flats in second bottoms and on ridges near water courses. It is surprising that a species that grows to such a large size and seems always to thrive so well in the bottoms should be so generally uncommon and local in its distribution. It undoubtedly prefers, and is seldom found away from, deep rich soils supplied with abundant moisture yet well-drained. It is also found on such sites in the uplands, seeming to prefer hammocks, coves and the banks of small rivers or streams.

Forest types in which most commonly found, and most common associates: There are apparently only three bottomland types in which Shumard red oak occurs: willow oak-cherrybark oak-cow oak, oak-hickory and red gum-loamy ridge oaks. It is most frequent in the first type named, least frequent in the last type named. Where found at all, it often occurs in small groups, but it apparently never makes up any but a very small part of the stand over a large area. It is most closely associated with cherrybark oak, cow oak, red gum, white ash, water oak (Quercus nigra L.), black gum, willow oak and terrace hickories.

General appearance: At its best, Shumard red oak is one of the largest oaks in the bottoms, developing a straight, tall trunk and a broad, rather open crown of stout wide-spreading branches. On young trees the bark is smooth or

SHUMARD RED OAK - Quercus shumardii Buckley

somewhat scaly, and usually lustrous in the lower part of the crown; on old trees the bark is very thick and usually characterized by pale or white-topped plate-like ridges between which the furrows are very rough and very dark-colored. The deeply-cleft leaves are thin, lustrous, dark green above, paler beneath, almost perfectly smooth (save for tufts of hair in the axils of the veins on the lower surface) and have an exceedingly large number of bristle-tips.

Distinguishing characteristics: The leaves and the fruit are the two most useful means of identification. The habitat and the bark are also helpful, but the latter does not always have distinct light-colored ridges with dark, rough areas between and may often closely resemble the bark of other oaks, e.g., Quercus nigra L. or Quercus velutina La Marck.

The leaves of mature trees are of almost uniform width, tapering only slightly at each end, and have long, very slender petioles. Each leaf has 7 to 9 broad lobes, separated by deep, usually narrow clefts. It is characteristic of the species that each lobe has numerous bristle-tips, the total number of bristle-tips on an entire leaf averaging about 25 to 35 and frequently running up to 45 or 50. The leaves most typical of Shumard red oak have the largest number of bristle-tips, many more on the average than does any other oak found in the bottoms. On small saplings the leaves are larger and thicker than on mature trees and usually taper sharply from a broad tip to a narrow base and short, stout petiole. The lobes of such leaves are irregular and shallow.

The acorn, the other important means of identification, is a rather large, light orange-brown nut ($\frac{1}{2}$ to $\frac{3}{4}$ -inch wide by $\frac{3}{4}$ to 1 inch long), either full and plump or definitely tapered with straight sides, borne in a shallow, rather flat, saucer-shaped cup. In the case of the variety schneckii (Britton) Sargent the cup

SHUMARD RED OAK - Quercus shumardii Buckley

is rather deep, but with the exception of this difference in the fruit the variety probably does not differ from the species. The variety is of uncertain occurrence in the Delta bottoms.

Shumard red oak does not closely resemble any other bottomland oak. It does somewhat resemble northern red oak (Quercus borealis Michaux f.) but that species has not yet been found and probably does not occur in the Delta bottomlands. In the case of identification in winter, when typical leaves and fruit can not be found beneath the tree (and the bark, habitat and form can not be relied upon except as indications) the winter buds can be depended upon to establish positive identification. The winter buds, borne on smooth, light grayish or brownish-green branchlets, are about $\frac{1}{4}$ -inch long, plump, ovoid, well-pointed, rather strongly-angled, smooth or only slightly downy, and distinctively soft light or grayish brown, often dull straw-colored. No other bottomland oak has winter buds of this description except Nuttall oak (Quercus nuttallii Palmer). As can be seen from the description of Quercus nuttallii on a later page, the two species in question are utterly different in distribution, habitat, leaves, fruit, bark and form. The similarity of winter buds should therefore cause no confusion.

Economic considerations: The wood of Shumard red oak is similar to that of northern red oak (Quercus borealis Michaux f.) and possibly of higher quality. It has a mild texture, the timber is of very good average quality and the tree is therefore utilized closely wherever found. The product gravitates rather heavily to such high-grade uses as furniture and cabinet work and even veneer, but the species is not distinguished by the lumber trade from other red oaks. It seems to be a thrifty tree with no notable defects or enemies.

Names in use in the Delta: Red oak, smooth-barked red oak, tight-barked red oak, yellow-butt oak, striped oak, Red River oak, swamp red oak, Mississippi Valley red oak, pin oak.

Distribution and habitat in the Delta: Nuttall oak is one of the most common trees of the low, poorly-drained clay, silty clay or occasionally loamy flats in both first and second bottoms. It is also common on fairly well-drained clay ridges in first bottoms but is very rare on loamy ridges. It is probably never found naturally outside the bottoms, in this respect differing from most other common bottomland oaks. It is rather well distributed throughout the Delta but it is principally a first bottom species and more or less restricted in second bottoms to the wetter flats where it is locally common. It is not usually found in permanent swamps and never in deep swamps but it is common in shallow swags and drains. The flats on which it is most typical have impervious clay soils and due to their poor drainage and the impossibility of surface runoff are usually covered with rain water to an average depth of 3 to 8 inches throughout the winter.

Forest types in which most commonly found, and most common associates:

Nuttall oak is found principally in the red gum-clay land oaks type where it is the principal "clay land oak" and usually the outstanding species. It is also common in the willow oak-cherrybark oak-cow oak type in first bottoms, in the red gum type on clay ridges and in the oak-elm-ash, hackberry-elm, southern cypress-hardwood, overcup oak-water hickory and willow oak types.

Its most common associates are red gum, American elm, persimmon, green ash, red maple, overcup oak, water hickory, water oak (Quercus obtusa Ashe), water oak (Quercus nigra L.), hackberry and hawthorn. Except in the red gum-clay land oaks type and very locally in the other types mentioned (especially

in well-stocked second growth on cut-over areas), Nuttall oak is not a species of primary importance. It is, however, a very widely distributed tree and at least several trees per acre can be found on almost any poorly-drained clay flat or low clay ridge.

General appearance: Small specimens of Nuttall oak have narrow, pyramidal crowns but large trees have rather broad, open, wide-spreading crowns. The lowermost branches are frequently drooping but the remainder of the crown is composed of ascending branches (often horizontal in the lower middle part of the crown). The bark of young trees is greenish-brown, smooth, tight, often lustrous. On large trees it is thin (seldom over 1 inch thick), exceedingly close, hard, firm, divided by shallow, irregular, narrow, pale fissures into broad, flat, scaly ridges, and light to dark grayish-brown in color. Small burls, warts and various excrescences are common. The trunk is ordinarily straight but not clear for any considerable length and on large trees it is almost always strongly buttressed. Nuttall oak is usually only a medium-sized tree but not infrequently becomes 100 to 120 feet high with a d.b.h. of 3 feet or more.

The leaves are rather dull dark green above, paler beneath, thin, firm, and entirely glabrous save for tufts of pale hair in the axils of the larger veins. They are moderately large (4 to 8 inches long by 2 to 5 inches wide) and typically tapered from just above the middle to a narrowed base and fairly long, slender petiole. There are usually 5 to 7 lobes separated by deep, wide, obtuse or angularly-rounded sinuses. The lobes at the widest part of the leaf are typically broad, angular, and look as though they had been abruptly cut off, either squarely or obliquely, at the ends. Many of the lowermost lobes are small, triangular and more or less entire, and on the small leaves common in

NUTTALL OAK - Quercus nuttallii Palmer

the upper part of the crown of large trees all the lobes are of that nature. The lobes are bristle-tipped but the total number of bristle tips on each leaf is not very great, averaging 10 to 25. The leaves are very variable in size and shape.

Distinguishing characteristics: The habitat and bark and leaf characteristics, considered together, will always separate Nuttall oak readily and sharply from all other bottomland oaks except pin oak (Quercus palustris Muench.). To distinguish between these two oaks requires observation of the fruit or the winter buds, preferably the former. Pin oak probably does not occur at all in Louisiana, whereas Nuttall oak is exceedingly common in that state. There should therefore be little or no chance of confusing the two in Louisiana. In Arkansas, however, where both species are common, and possibly in central and northern Mississippi where the two ranges are imperfectly known, there will frequently be difficulty in making positive identification. The habitat and bark are often practically identical. The form of the tree and the leaves are so nearly the same, in the usual absence of a uniform set of perfectly typical characteristics, that they should not be relied upon to separate the two. What slight differences there seem to be between typical leaves of the two species can be summarized briefly as follows: nuttallii leaves are rather dull, or at least not very glossy or lustrous on the upper surface; palustris leaves are ordinarily distinctly lustrous above. Nuttallii leaves are hardly ever 9-lobed; palustris leaves are rather frequently 9-lobed. Nuttallii leaves (except from the tops of large crowns or the tips of large branches) are generally broader and less acuminate at the tip than are palustris leaves and have slightly shorter petioles and more angular, more widely divergent, broader, lateral lobes with more sharply truncate ends; they are also much more commonly broadest just above the middle, with a sharp taper toward a narrow cuneate base, than are palustris leaves.

The fruit or the winter buds, or both, must therefore be observed.

These are both typically very different in the two species and, although variations will be found that will occasionally make separation difficult, in the vast majority of cases they can be depended upon to point out the correct identification. The fruit of Nuttall oak is an oblong-ovoid acorn, $\frac{1}{2}$ to 1 inch wide by $\frac{3}{4}$ to $1\frac{1}{4}$ inch long, that is enclosed for from one-fourth to one-half of its length in a thick-based deep cup, the base of which is drawn out into a distinct, stout, short stalk. The fruit of pin oak is an almost hemispherical acorn, rarely over $\frac{1}{2}$ -inch in length and breadth, that is enclosed for about one-fourth (sometimes more) of its length in a thin, shallow, saucer-like cup. The size and shape of the acorn and the thickness, shape and depth of the cup are the important points to be noted. The color of each acorn is much the same (light to dark lustrous reddish-brown) and each is usually striped.

The winter buds of Nuttall oak are usually just a shade less than $\frac{1}{4}$ -inch long, plump, ovoid, acute at the apex, inconspicuously angled, light medium or grayish-brown or dull straw color, and entirely smooth or only slightly downy. The winter buds of pin oak are rarely over $\frac{1}{8}$ -inch long, plump, ovate, acute at the apex, rarely angled, light chestnut brown and more or less smooth. Nuttall oak buds strongly resemble and are hardly distinguishable from those of Shumard red oak. Their greater size and usually distinctive color are the important characteristics separating them from the buds of pin oak.

Economic considerations: Nuttall oak makes up a large part of the total cut of oak from the first bottoms. It is usually cut for lumber wherever found on logging operations.

It is of more than average susceptibility to fire injury and resultant fungus damage. Two insects also are very injurious. A leaf beetle or skeletonizer caused great damage in 1927 and 1928 in central and southern Louisiana and

grub infestations are generally prevalent in damaged or stagnant individuals.

The tree often has a relatively short bole and many adherent horizontal or drooping limbs in the lower part of the crown, resulting in logs with many pin knots. Mineral stain is also common.

However, with the exception of red gum and ash, Nuttall oak is usually of better quality than other trees found on its typical site. By careful selection it is usually possible to cut logs that will yield a fair to excellent average grade of lumber. In young stands or at least in stands that are not over-mature, the average quality of Nuttall oak is very high indeed and there are very few defects. It is seldom cut for products other than lumber, but occasionally goes into cooperage and tie stock. It is well liked in cooperage work.

The wood is redder and has a more uniform texture than any other oak found typically on low, poorly-drained sites. It is hard, heavy and inclined to check excessively. The red heartwood usually has a dull brownish cast and the sapwood has a yellow cast.

Nuttall oak is not utilized very closely because of the necessity of careful selection of lumber logs and the impracticability of cutting it for ties. The stands are inaccessible to the average portable tie mill for a large part of the year and the timber is not particularly suitable for tie production.

It is one of the few timber trees to grow well, or even at all, on poorly-drained clay flats. Its rate of growth is fair to good on flats and extremely good on clay ridges. The tree is usually of only medium size at maturity. While it ordinarily reaches maturity in excellent condition, it degenerates very rapidly thereafter.

NUTTALL OAK - Quercus nuttallii Palmer

BLACK OAK - Quercus velutina La Marck

Names in use in the Delta: Black oak, red oak (by many lumbermen and in the trade).

Distribution and habitat in the Delta: Found throughout the Delta region but not common anywhere in the bottomlands. Common on many of the loessial uplands included in the general Delta region; e.g., Crowley's Ridge in east central Arkansas.

In the bottoms, black oak occurs only on the highest and best-drained loamy ridges, exclusively on the second or higher bottoms or old terraces. It prefers a sandy, loamy or gravelly soil and is probably never found on clay soils. It is much more common in Arkansas than in Louisiana or Mississippi.

Forest types in which most commonly found, and most common associates: There are probably only three bottomland types in which black oak occurs: oak-hickory, red gum-loamy ridge oaks and loblolly pine-hardwood. It is somewhat more common in the first two types but in either case is found only as a rare to occasional component of the stand. It usually is most closely associated in these types with southern red oak, white oak and terrace hickories.

General appearance: In the Delta bottoms, black oak is usually only a small to medium-sized tree. Its bark is firmly and rather deeply ridged, very dark, almost black, and very rough. The leaves are large, broad, coarse, thick, 5 to 7-lobed, very dark green and lustrous above, paler green beneath. Their shape is very variable, but they are usually widest above the middle and not much narrowed at either end. The tree ordinarily develops a straight stem and has a well-developed crown.

Distinguishing characteristics: The bright or deep orange-yellow inner

BLACK OAK - Quercus velutina La Marck

bark is the most outstanding distinguishing characteristic. Ordinarily, however, it is not necessary to examine the inner bark because the very dark, very rough bark, the long and stout-petioled, large, coarse, 5 to 7-lobed leaves, very dark green and lustrous above and paler and slightly hairy beneath, and the habitat, usually make identification easy. The winter buds are unlike those of any other bottomland oak. They are large ($\frac{1}{4}$ to $\frac{1}{2}$ -inch long), strongly angled, rather sharply pointed, and covered with dense yellowish-gray hairs.

Black oak surface bark rather closely resembles that of southern red oak (Quercus rubra L.), and in the bottomlands they occupy the same sites, but the two trees should not be confused because their respective inner bark, leaves, fruit and winter buds are not at all similar. The inner bark of Quercus rubra is somewhat yellow but has not the deep orange-yellow cast of Quercus velutina. The leaves of Quercus rubra are very pale grayish-green and very velvety beneath, in striking contrast to the lustrous dark green upper surface, whereas the leaves of Quercus velutina are only slightly paler (and still green or brownish-green) beneath than above and only slightly hairy on the under surface. The leaves of Quercus rubra have rather narrow, more or less acuminate, and often entire lobes and the leaves of small or young trees (not infrequently of large trees) usually have relatively narrow 3-lobed leaves. Quercus velutina, on the other hand, always has relatively broad leaves with rather broad, rarely acuminate, and almost never entire lobes. The fruit of Quercus rubra most commonly has a shallow saucer-like cup that encloses no more than one-third of the nut at most, whereas the fruit of Quercus velutina most commonly has a relatively deep cup that encloses at least one-half of the nut. In contrast to the large, pale, hairy buds of Quercus velutina, the winter buds of Quercus rubra are rarely over $\frac{1}{4}$ -inch long, bright reddish-brown and only slightly downy.

BLACK OAK - Quercus velutina La Marck

Small trees of black oak and cherrybark oak (Quercus rubra pagodaefolia (Elliott) Ashe and Quercus rubra leucophylla Ashe) might possibly be confused if the leaves are not carefully examined, but the pale to dark gray, smooth to scaly, thin surface bark and pale yellowish inner bark of the latter should offer sufficient contrast to the very dark brown or black, rough or platy, thick surface bark and deep orange-yellow inner bark of black oak to enable one to distinguish each species very easily.

Economic considerations: Black oak is of sufficiently widespread general occurrence to be of considerable importance but it contributes very little to the total cut of Delta oaks and in the Delta alone is of very little importance. It is generally cut wherever encountered in ordinary logging operations. The technical properties, the appearance and the uses of the wood are very similar to those of southern red oak (Quercus rubra L.). On its usual good sites it is relatively free from disease and insect infestations and it is not unusually susceptible to any form of injury.

BLACK OAK - Quercus velutina La Marche

SOUTHERN RED OAK - Quercus rubra L.

Name in use in the Delta: Red oak.

Distribution and habitat in the Delta: Like Quercus velutina La Marck, found throughout the Delta region but not common anywhere in the bottomlands. It is an upland tree that is found in the bottoms only on the highest and best drained loamy ridges of the second or higher bottoms. Its general distribution in the South is much the same as that of Quercus velutina, but Quercus rubra is the more common tree, on either upland or bottomland.

Forest types in which most commonly found, and most common associates:

Southern red oak in the bottomlands is found only in the same three types in which Quercus velutina occurs: oak-hickory, red gum-loamy ridge oaks, and loblolly pine-hardwood. Again like black oak, it occurs only as scattered individuals that contribute very little to the stand as a whole. Its closest associates in the bottoms are white oak, post oak, red gum, black gum, loblolly pine, terrace hickories, winged elm and black oak.

General appearance: In the Delta bottoms, southern red oak is ordinarily only a small to medium-sized tree. It develops a straight trunk and a well-developed crown. The bark, even of small trees, is exceedingly dark, almost black, very rough and very thick. The leaves are usually rather large and are coarse and thick. They are dark green and lustrous above but pale grayish-green and very velvety beneath. The contrast is very striking. They are from 3 to 7-lobed and extremely variable in shape but perhaps most commonly have a long 3-pronged or tongue-like terminal lobe that can be recognized from a considerable distance.

Distinguishing characteristics: The very dark brownish-black, very rough and very thick bark, even of young trees, is a very prominent and characteristic

SOUTHERN RED OAK - Quercus rubra L.

feature. This bark, while more or less closely resembling black oak, is ordinarily darker, rougher and thicker for trees of the same size. The inner bark, however, can always be used to separate the two trees (see under Quercus velutina La Marck).

The leaves of southern red oak, aside from the contrast between the upper and lower surfaces noted above, have a distinctive shape that can always be recognized even though the variation of leaf pattern is very great. On many trees, especially small or immature specimens, the leaves are relatively narrow, rounded and narrowed at the base and 3-lobed or forked at the apex. If not of this pattern, the leaves are 5-(or infrequently 7-)lobed, with abrupt, wide-spreading, narrowly-triangular, sharp-pointed lateral lobes that are most frequently entire but otherwise have several small bristle-tipped teeth. The terminal lobe is usually long and 3-pronged or tongue-like. The lobes are generally separated by very wide and very deep sinuses. Cherrybark oak (Quercus rubra pagodaefolia (Elliott) Ashe and Quercus rubra leucophylla Ashe) is the only other bottomland oak with leaves at all similar. Mature cherrybark oak leaves, however, have more lobes (5 to 11) and are generally less deeply cleft. In the case of the immature form of leaf of Quercus rubra leucophylla found on small trees and in the lower part of the crown of large trees, the distinction is readily made because such cherrybark oak leaves are rather broad and very shallowly lobed, bearing no resemblance whatever to any of the leaf forms of southern red oak.

Detailed points of difference between southern red oak and black oak, with which it is most apt to be confused, are given in the section devoted to black oak (Quercus velutina La Marck). In the event that the leaves are not typical or not carefully examined, bark characteristics should be used to separate southern red oak from cherrybark oak. The bark of the former has

SOUTHERN RED OAK - Quercus rubra L.

already been described. The bark of small cherrybark oaks is thin, pale gray, tight, almost smooth, with many shallow fissures, breaking into small, scaly ridges at the butt. On large trees the bark is still relatively thin and completely broken up into small scaly ridges, the scales $\frac{1}{2}$ to 1 inch wide, closely appressed and pale to dark gray in color. The inner bark is bright reddish-brown or salmon pink. The bark of the two species is therefore so different that there should never be any confusion concerning their identity.

Southern red oak differs so markedly from all other bottomland oaks that no other points of distinction need be mentioned.

Economic considerations: Southern red oak is of minor commercial importance in the Delta due to its local distribution and usual lack of abundance in mature stands and to its variable quality. It is generally recognized as a distinct species and it is usually cut wherever found in ordinary logging operations, but it is not especially adapted to any specific product (except possibly ties) and makes up only a very small part of the total cut of oak in the Delta.

Southern red oak is very hardy and resistant to fungi and insects and is of only average susceptibility to fire injury. Even on good sites, however, the tree typically has a short bole and tends to have a heavy crown with many large branches on the upper part of the bole. For this reason, despite its usually clean and well-formed lower bole, it is not very desirable as a source of lumber because more than two lumber mill logs can rarely be cut, and usually only one high-grade lumber mill log can be cut, from a single tree. The upper cuts frequently have such coarse knots that they are not suitable for structural or railroad material. On poor sites it is almost always too limby for lumber, and although it contains good tie timber it is usually too short-boled to be an

SOUTHERN RED OAK - Quercus rubra L.

especially desirable source of ties. Due to the variable quality and the short bole, utilization for lumber is probably less close than for most other oaks.

The better class of lumber mill logs usually cut out very satisfactorily. The wood is probably the reddest of all the oaks, has a good texture and is straight-grained, soft and usually mild and easily cured. Its softness is largely accounted for by its ordinarily slow growth. Heavy structural pieces will cure without checking and splitting and there is usually a very slight amount of sapwood.

In the Delta bottomlands, on consistently good sites, southern red oak is usually cut for lumber. On poor sites outside the Delta, however, where the tree is infinitely more common, it is rarely cut for lumber but frequently used for railroad and structural material.

CHERRYBARK OAK - Quercus rubra pagodaefolia (Elliott) Ashe

and Quercus rubra leucophylla Ashe

(Swamp red oak in Sudworth)

Names in use in the Delta: Cherrybark oak, cherrybark red oak, red oak, yellow-butt oak.

Distribution and habitat in the Delta: Cherrybark oak is very common and well distributed throughout the Delta bottoms on loamy ridges. In fact it is one of the characteristic and most common species on loamy ridges in both first and second bottoms, including old fields. It is also very common on hummocky or washboardy topography. It is rare on flats in the first bottoms, but occasional on flats in the second bottoms. From southern Arkansas northward, cherrybark oak is confined principally to second bottoms. It develops best on a loamy well-drained soil, especially on old fields. It is uncommon on clay ridges, although it generally is of good form and quality on those sites. On clay flats, however, where it is very rare, the form and quality are usually very poor. Its form and quality on washboardy topography are generally fair.

Forest types in which most commonly found, and most common associates:

Cherrybark oak is most common and most typical in the red gum-loamy ridge oaks type, where it is the principal "loamy ridge oak" and often the most abundant species. It is next most common in the willow oak-cherrybark oak-cow oak type, which is so often found on washboardy and hummocky topography. Cherrybark oak also occurs (but is seldom abundant) in the oak-hickory, red gum, loblolly pine-hardwood and oak-olm-ash types, named in the approximate order of decreasing occurrence. In the last three types, cherrybark oak is usually a very minor

CHERRYBARK OAK - Quercus rubra pagodaefolia (Elliott) Ashe
and Quercus rubra leucophylla Ashe

component at best. Single specimens have been found in the hackberry-elm and even in the overcup oak-water hickory types.

Cherrybark oak is usually most closely associated with red gum, water oak (Quercus nigra L.) and cow oak. Due to its occurrence in so many different types, however, its associates are naturally very numerous and quite diverse; a complete list of them would be very long and rather meaningless. The three species just named are most characteristically associated with cherrybark oak and no other species seems to belong to that small group.

General appearance: Cherrybark oak at its best is one of the largest of the Delta oaks, perhaps the very largest. It is often 100 to 130 feet high and 3 to 4 feet in d.b.h. and not infrequently even larger. On its best sites it is also one of the two fastest-growing of the Delta oaks (the other being Quercus nigra L.). The tree develops a straight, tall trunk that in old veterans is almost cylindrical to the base of the crown. It is very rarely buttressed. The crown is broad, rather open and composed of very stout branches. The bark of the mature trunk is pale to dark gray and completely broken up into rather thin, small, firm, closely-appressed scaly ridges (the scales about one inch wide and one to several inches long). The bark bears a superficial resemblance to that of black cherry, Prunus serotina Ehrhart (reported from very high loamy terraces and occasional upland "islands" in the Delta), whence the common name. The leaves are coarse, dark green and lustrous above, pale grayish-brown and downy beneath, deeply and widely cleft (except the lowermost leaves of Quercus rubra leucophylla Ashe) into long, sharply-tapered, widely-flaring, often entire, lobes.

Distinguishing characteristics: The bark and leaf characters in conjunction with the habitat and form are so distinctive that cherrybark oak should very rarely be confused with other bottomland oaks. The fruits of cherrybark oak and southern red oak (of which cherrybark is of course a variety) are identical. The

CHERRYBARK OAK - Quercus rubra pagodaefolia (Elliott) Ashe
and Quercus rubra leucophylla Ashe

confusion of these two trees is nevertheless very unlikely. Several sharp points of distinction are given under Quercus rubra L. It will be noted that two varieties (Quercus rubra pagodaefolia (Elliott) Ashe and Quercus rubra leucophylla Ashe) are known by the one name, cherrybark oak. Probably the only differences between the two varieties are (1) that in the former the deeply-forked type of leaf is found throughout the crown of the tree whereas in the latter variety the deeply-forked type of leaf is not found at all in the lower portion of the crown of large trees and is entirely absent from the crowns of small saplings, and (2) that in leucophylla there is a more pronounced brown pubescence on the under side of the leaves. Where the deeply-forked type of leaf is absent in leucophylla there is found a thinner, very shallowly-lobed type that shows very little contrast between the upper and lower surfaces and that characteristically remains on the tree until the buds unfold in spring. Aside from these leaf characters the two varieties are apparently identical. The variety leucophylla, with the two types of leaves, is by far the most common in the Delta.

Economic considerations: Cherrybark oak is recognized by all lumbermen familiar with it as the outstanding red oak of the South with respect to commercial value. There is a plentiful supply of cherrybark oak lumber and it is of the most uniformly high grades and has the most uniformly good working qualities of any of the red oak group in the South. Probably the only red oaks comparable to cherrybark oak in this respect are northern red oak (Quercus borealis Michaux f.) and black oak (Quercus velutina La Marck). The first of these probably does not occur at all in the Delta bottoms and the second is very uncommon. Cherrybark oak is also one of the hardiest and fastest-growing of the oaks, or even of hardwoods in general, and grows well upon a greater variety of sites than any other bottomland oak except water oak (Quercus nigra L.). From

CHERRYBARK OAK - Quercus rubra pagodaefolia (Elliott) Ashe
and Quercus rubra leucophylla Ashe

any point of view cherrybark oak is an exceptionally fine timber tree.

It is apparently not very susceptible to any form of damage. As with most timber trees, fire is its chief enemy but fire damage is usually no more severe than in other species. Grubs and pin worms often cause much damage in badly fire-damaged veterans and in overmature timber but no insects or fungi seem to be a primary cause of damage. The tree is apt, however, to produce many small adventitious limbs after release and thus produce logs with abundant pin knots. It is also subject to a blue mineral stain that seems to be associated with fire damage.

Because of its general high quality, cherrybark oak lumber is used to an unusually great extent for high-grade products such as finish, large fixtures and paneling. In texture and working qualities the lumber ranks high. It is usually firm to hard, but always straight-grained and workable even at its hardest. Its color is of a satisfactorily uniform light red or pink shade similar to the red oaks of the North. Because of its unusually high quality it is probably cut smaller and closer than average oak timber.

Cherrybark oak as cooperage material is probably the most generally used and most satisfactory of the red oaks of the South. It is also a favorite for ties, car stock, poles, piling, etc., because it not only frequently grows in well-stocked second-growth stands where it develops a form highly suitable for such products, but it also is less likely to check or become damaged after manufacture than the other Delta red oaks.

It must be recognized of course that the quality varies from locality to locality according to site and the thriftiness of the stand. Considerable amounts of mature cherrybark oak will occasionally be found on sites to which the species is not adapted and the timber is then usually grubby and mineral-

CHERRYBARK OAK - Quercus rubra pagodaefolia (Elliott) Ashe
and Quercus rubra leucophylla Ashe

streaked. A considerable amount of timber of this kind on flats died shortly after the 1924 drought. Fires and hurricanes also seem to be instrumental in introducing grub and mineral stain into extensive stands of cherrybark oak.

CHERRYBARK OAK - Quercus rubra pagodaefolia (Elliott) Ashe
and Quercus rubra leucophylla Ashe

WATER OAK - Quercus nigra L.

NOTE: Both this species and Quercus obtusa Ashe are given the same common name, "water oak", by Sudworth. Ordinarily in either writing or speaking about either species, one can add the appropriate scientific name to make it perfectly clear which is meant. In this section and the one following, however, to avoid constant repetition of both common and scientific names, Quercus nigra L. is called "nigra oak" and Quercus obtusa Ashe is called "obtusa oak". This entails the same incongruous but effective nomenclature recently sanctioned by the Forest Service in the instance of Pinus ponderosa Lawson, the official common name of which is now "ponderosa pine" instead of the former familiar "western yellow pine". "Nigra oak" and "obtusa oak" are already in some practical use in the Delta by foresters who needed short, distinctive common names for the two. "Nigra oak" is not recommended as an official name because the tree has been known from earliest times, and is at present widely known, as "water oak". To avoid confusion, however, "obtusa oak" is suggested and recommended as an official name for the more recently described Quercus obtusa Ashe.

Names in use in the Delta: Water oak, spotted oak, pin oak, red oak.

Distribution and habitat in the Delta: Nigra oak is one of the most common and most widely distributed trees in the southern half of the Delta region, where red gum is its only rival with respect to abundance and frequency of occurrence. Above southern Arkansas, however, it is only occasional and it does not quite reach to the northernmost tip of the Delta region between Cairo, Illinois and Cape Girardeau, Missouri. In its center of abundance in the lower half of the Delta, nigra oak is found on almost every site in the bottoms except permanent deep swamps and low-lying batture land with frequently overflowed sand or clay

WATER OAK - Quercus nigra L.

soils. It also occurs on a great variety of sites outside the bottoms in the Delta region and throughout the South.

Nigra oak is not, however, found equally commonly on all the bottomland sites on which it occurs. It seems definitely to prefer the better-drained, silty clay or loamy ridges, especially the latter, and the border-line sites between definite flats and ridges. On old fields it is often a very abundant species although on certain soils and in certain regions it is far outranked by red gum in this respect. In the region of St. Landry Parish, Louisiana, nigra oak is the outstanding species on old fields. In general, nigra predominates on second bottom old fields whereas red gum predominates on first bottom old fields. Nigra oak is common on the better-drained flats on terraces and in pockets or depressions in well-drained ridges as well as on the ridges proper. It is rare on poorly-drained clay flats and the few specimens found there are almost always of poor form and quality. Its best development is on ridges, perhaps especially on old fields. It shows no marked preference between first and second bottoms but is somewhat more common and of better average form and quality in first bottoms.

Forest types in which most commonly found, and most common associates:

Nigra oak is probably most common in the red gum-loamy ridge oaks type, and next most common in the red gum-clay land oaks type on low clay or silty clay ridges, and in the red gum type. It is also more or less common in the willow oak-cherrybark oak-cow oak, oak-hickory, loblolly pine-hardwood and oak-elm-ash types and it is found occasionally in several other bottomland types. In second-growth stands on old fields nigra oak is occasionally the outstanding species, but with this exception it is usually not a predominant species even on favorable sites. It is, however, at least an important associate species on many of its most favored sites and frequently makes up a considerable proportion of the merchantable volume at such places.

WATER OAK - Quercus nigra L.

Due to the large number of sites and types in which nigra oak occurs, a list of its most common associates would be very long; however, no one species with the possible exception of red gum, can be said to be associated with it in a majority of instances. Ordinarily, in any given type the common associates of nigra oak are simply the species most common in that type. In second-growth old-field stands in the southern half of the Delta nigra oak and cherrybark oak together frequently make up 80 to 90 per cent or more of the stand.

General appearance: Nigra oak generally develops a straight, tall, slender trunk and a symmetrical, round-topped crown of distinctly ascending, slender branches and branchlets. In the forest it frequently reaches a height of 100 to 125 feet, but the trunk is rarely massive except in individuals growing in open fields or pastures or as shade trees. The trunk is usually slow to prune itself and small dead limbs or their stubs remain on the tree for a considerable time. The bark of young trees is very shallowly and narrowly fissured, tight, close, thin, and looks smooth from a short distance. It is light grayish-brown and usually has numerous irregular patches, bands or spots (hence one common name) of a pinkish, yellowish or orange color. On older or mature trees the bark is still relatively tight, close, thin, and broken up into low, broad, roughened scaly ridges by pale, narrow, shallow fissures. In color it is dark grayish-black or steel gray, but there are frequent patches of smoother, paler bark. The leaves are extremely variable (much more so than on any other bottomland oak) but generally small (2 to 4 inches long by 1 to 2 inches wide), and tapering gradually from a broad, rounded and entire, or irregularly 3-lobed, apex to a narrowed, cuneate base and short, stout, flattened petioles, $1/8$ to $1/2$ inch long. The leaves may, however, be deeply lobed with 3 to 7 short, triangular

WATER OAK - Quercus nigra L.

bristle-tipped lobes, or abruptly and deeply 3-lobed at the apex, or very long (1 to 6 or more inches), narrow and with entire margins. On small seedlings the leaves are generally very long, narrow and either entire or deeply and strikingly lobed or forked. All types of leaf may be found on a single tree or but one type may be found. The mature leaves are very dark green above, paler beneath, thin but tough and very firm, and practically glabrous on both surfaces. They rarely fall until very late in the winter and at least a few to practically all of the leaves remain until the new leaves unfold.

Distinguishing characteristics: Despite their extreme variability, the leaves of nigra oak afford the best means of identification. The various types of leaf, different as they are, will rarely be confused with leaves of other bottomland oaks, especially when their dark color, firm and stiff texture, and semi-evergreen character are taken into consideration. Nigra oak is characteristically the very last bottomland oak (except the truly evergreen live oak, Quercus virginiana Miller and possibly obtusa oak, Quercus obtusa Ashe) to lose its leaves in the winter. Leaves of Quercus nigra and Quercus obtusa may occasionally be confused but there is little reason for such confusion because those of nigra, whatever their shape, are seldom distinctly widest at the very middle of the blade, tapering rather evenly to the base and to the apex, whereas obtusa leaves are practically always distinctly widest at the middle and taper gradually and evenly to each end.

The slender ascending branches that droop only at or near their tips, often forming a crown that reminds one of an elm, and the tall, tight-barked, gray-black trunk, are also characteristic. The bark alone of mature trees may often strongly resemble that of Quercus nuttallii and Quercus palustris but the generally darker-colored, rougher bark of nigra oak, with its irregular, pale

WATER OAK - Quercus nigra L.

smooth and somewhat shiny patches, is generally distinctive. The bark is also darker and rougher than that of obtusa oak with which it might also occasionally be confused, and moreover it very rarely is warty or greenish like that of the latter tree. The fruit of nigra oak, a small, ovoid acorn in a thin, saucer-shaped cup, is usually produced abundantly but ordinarily is not needed to clinch an identification. Superficially it looks like the fruit of several other bottom-land oaks, e.g., obtusa oak and willow oak (Quercus phellos L.).

Economic considerations: As the outstanding member of the water oak subgroup, nigra oak is often distinguished from the other species of the red oak group. It is a very important species from the standpoint of total cut over a wide area, general utility and fair quality. Its extensive use, however, is of comparatively recent development, probably beginning at the same time that the extensive exploitation of red gum had its origin.

Nigra oak is conspicuously subject to blue and green mineral stain and seems to be somewhat more susceptible to fire injury than most other oaks. Insects and fungi rarely are the primary causes of serious damage. The bole usually bears numerous adherent branches (dead stubs on the upper part of the bole are more or less characteristic) and the resultant pin knots constitute the greatest and most common defect of the species.

It is one of the most variable red oaks with respect to quality. The average quality is only medium and strangely enough the poorest trees and stands have attracted the most notice and the most comment. Poor trees and stands occur on very poorly-drained, heavy soils at the one extreme and on excessively drained, light sandy soils at the other. The latter condition produces unusually poor specimens. All the defects noted above, and also grubbiness, are more pronounced on poor sites. On good sites, however, such as moist, well-drained,

WATER OAK - Quercus nigra L.

loamy ridges in first bottoms, nigra oak is often abundant in well-stocked stands and almost always develops clean, straight and tall stems that are excellent sources of lumber.

The wood is hard and heavy but in its better phases has very good working qualities. It has a mild, light reddish or tan-colored heartwood and white, unusually wide sapwood. It is put to all the varied uses for which oak timber is suitable but because of its texture and its average grade it is especially adapted to flooring. It is also well suited to railroad and structural purposes.

It is almost always cut for lumber wherever found in logging operations in the Delta, but the trees are usually rather carefully selected and the utilization is not very close. In tie or pole operations in good stands, utilization is usually closer than average because of the favorable form.

Nigra oak grows at an exceedingly fast rate. It is rivalled only by cherrybark oak among the oaks and compares favorably with cottonwood and loblolly pine. Many stands from 50 to 70 years old are logged for lumber. Nigra oak ranks with cherrybark oak as an outstanding southern oak. It has a wide adaptability to various commercial as well as silvicultural purposes, reproduces exceedingly well and is at least normally thrifty and hardy except on the poorest sites. With cherrybark oak, which is of higher average quality, it should be widely grown under forest management and, within its range, probably more widely than cherrybark oak because of its adaptability to a greater range of sites.

WATER OAK - Quercus nigra L.

NOTE: This species is called "obtusa oak" in the following section in accordance with the NOTE under water oak, Quercus nigra L. (q.v.).

Names in use in the Delta: Water oak, pin oak, spotted oak.

Distribution and habitat in the Delta: Obtusa oak is found in the Delta probably only in the region south of the Red River in Louisiana but possibly also in the backwater area north of the river. Throughout its limited range it occupies low wet flats, the borders of swamps, ponds, and sloughs, and washboardy and hummocky topography (in the depressions). It is generally of local occurrence, but over small, isolated areas may be common.

Forest types in which most commonly found, and most common associates:

Obtusa oak is found in the red gum-clay land oaks, overcup oak-water hickory, willow oak-cherrybark oak-cow oak, hackberry-elm, oak-elm-ash and southern cypress-hardwood types. In none of these types is obtusa oak an important or common species except, occasionally, very locally. It is generally a tree of very scattered and infrequent occurrence. Its most common associates are Nuttall oak, overcup oak, green ash, American elm, water hickory, hackberry, honey locust, red gum and red maple.

General appearance: Obtusa oak at its best has a tall trunk with a wide-spreading crown of stout branches and slender branchlets. Commonly, however, it appears rather scrubby in appearance, with a short trunk and an irregular, much-branched, heavy crown. It is said to reach a height of 150 feet with a d.b.h. of 4.5 feet but most of the specimens seen in the bottoms of central Louisiana are less than half that size. The trunk has a distinctive, thin, light-gray or greenish, very smooth, very shallowly-furrowed bark frequently marked with warts, white lichens and various excrescences. The leaves are rather small (3 to 4

WATER OAK - Quercus obtusa Ashe

inches long by 1 to 2 inches wide), thin, very dark green and lustrous above, pale beneath, distinctly broadest at the middle of the blade and tapering one way to a narrow, acute or rounded apex and the other way to a narrow, cuneate base and a short, stout, yellow petiole, $\frac{1}{4}$ to $\frac{1}{2}$ -inch long. The margins are entire or slightly undulate and the taper each way from the middle is of about the same degree. The leaves are very slow to fall in the winter and are possibly even more nearly evergreen than those of *Quercus nigra* L.

Distinguishing characteristics: The distribution and habitat of obtusa oak and its bark and leaf characteristics are generally sufficient, taken as a whole, to separate this species from all others. The differences between *Quercus obtusa* Ashe and the closely allied *Quercus nigra* L. with respect to bark and leaves are described in the section devoted to the latter species. Obtusa oak can hardly be confused with any other oak within its limited bottom-land range save possibly willow oak (*Quercus phellos* L.). Shingle oak (*Quercus imbricaria* Michaux), with which it might otherwise conceivably be confused, is even more confined within the Delta to the northernmost part than obtusa oak is to the southern part. Willow oak has distinctly narrow, willow-like leaves of almost uniform width that are practically never distinctly widest at the middle, and the bark of mature trees is very dark, very rough, much corrugated and ridged, and very thick--in all these respects quite the opposite of obtusa oak.

Economic considerations: Obtusa oak is of minor commercial importance because it is neither plentiful, easily accessible, nor of high average quality. However, it produces a fair proportion of reasonably good logs and is ordinarily cut wherever encountered in logging operations. It contributes a small amount to the output of nearly all Gulf Coast hardwood mills. Utilization in the woods is usually not close because of the habit of the tree, its low average quality and the frequently unfavorable logging conditions.

Obtusa oak is of average susceptibility to fire injury but of much more than average susceptibility to mineral stain, grubs and bird peck. There is usually no serious damage from other insects or from fungi. The trunk is apt to have many adherent limbs, especially large limbs that form the lower part of the crown, and trees containing more than two good logs are therefore very uncommon. Even good second logs are not common. The wood is of first-class appearance, straight-grained but hard, heavy and inclined to check badly in drying. The sapwood is cream-colored and unusually wide.

Obtusa oak is cut almost entirely for lumber mills because neither the tree nor the types or sites where it is found lend themselves to any special kind of operation (e.g., a tie operation). Since its average quality is rather low, there is a tendency for the lumber to go into lower-than-average grades and because of its texture it is used more for flooring than for furniture. It is not extensively cut into construction material, principally because of its seasoning qualities, but a small amount of obtusa oak is undoubtedly used as railroad material and planking.

WILLOW OAK - Quercus phellos L.

Names in use in the Delta: Willow oak, pin oak (most commonly used), rough-barked oak.

Distribution and habitat in the Delta: Willow oak is well distributed throughout the entire Delta. It is especially common in the Delta region of Arkansas where it is probably the most widely-distributed oak in the bottoms. On its favorite sites it is occasional to common everywhere in the Delta. Willow oak is typically found on poorly-drained flats (especially silty or loamy flats in second bottoms) that are normally covered each winter with a shallow sheet or pools of standing water, the result not of overflow but of winter rains that can neither drain down through the soil because of an impervious subsoil and resultant water-logged condition, nor flow off because of the low, flat or basin-like topography. In the second bottoms it is about as common on poorly-drained clay flats as Nuttall oak and it is frequently the predominant species on poorly-drained silty or loamy flats. It also occurs very commonly on washboard topography (in the depressions), in small local depressions or basins in loamy ridges and, in the first bottoms, on clay ridges. It is rare on the typical first bottom flats subject to overflow by backwater (where Nuttall oak is the common oak).

Forest types in which most commonly found, and most common associates:

Willow oak is particularly prominent in the willow oak type (found principally on poorly-drained loamy flats in second bottoms) and in the willow oak-cherrybark oak-cow oak type (found principally on hummocky and washboard topography. In the other bottomland types in which willow oak occurs it is rarely of more than secondary importance but is generally present and locally very common. These types are mainly the red gum-clay land oaks, red gum (on

WILLOW OAK - Quercus phellos L.

low clay ridges; very important in first bottoms), oak-elm-ash (a cut-over variant, willow oak-cedar elm, is very common, especially in Arkansas), hackberry-elm, oak-hickory (on flats in Arkansas), overcup oak-water hickory (as a very minor component, largely in second bottoms), and loblolly pine-hardwood types.

On clay flats in either first or second bottoms the most common associates of willow oak are Nuttall oak, overcup oak, cedar elm, American elm, water hickory, persimmon and green ash. On clay ridges in first bottoms, red gum is the chief associate. On silty or loamy flats in second bottoms, winged elm is the most characteristic associate; other common associates are American elm, persimmon, green ash, overcup oak and water hickory. On washboardy or hummocky topography, willow oak occurs intimately mixed with cherrybark, post and cow oaks, which three are, however, on the higher elevations while willow oak is in the depressions. Elsewhere willow oak associates with the common trees of the particular type in which it occurs.

General appearance: Willow oak is a medium to large-sized tree in the Delta, not infrequently becoming 100 to 120 feet high with a d.b.h. of 3 feet or more. It usually develops a tall, straight trunk and a full, rounded, symmetrical crown of numerous slender branches. The trunk prunes itself rather slowly. There are usually numerous small live and dead branches that are long persistent on the trunk and greatly reduce the clear length. The lower limbs typically droop or are horizontal and droop at the ends. In the remainder of the crown the branches ascend but droop at the ends. There are usually abundant short, pin or spur-like branchlets, especially on the lower branches, hence the name pin oak so widely used in the Delta. The trunk of small trees is light steel gray to brownish or reddish-gray, very closely appressed, very hard,

WILLOW OAK - Quercus phellos L.

appearing rather smooth from a short distance, but actually very rough on the surface, becoming rougher and darker toward the butt. On large mature trees it is typically very dark grayish-black and deeply corrugated by very rough-surfaced, hard, thick ridges. The bark is exceedingly thick and the tops of the ridges are usually much paler in color than the rough black areas between. The leaves are willow-like, small to medium-sized ($2\frac{1}{2}$ to 5 inches long by $\frac{1}{4}$ to 1 inch wide), relatively long and narrow, narrowed and acute at the ends, with entire or slightly undulate margins, vivid light green and rather lustrous above, dull and paler below, essentially smooth, with stout, very short (about $\frac{1}{8}$ -inch long) petioles.

Distinguishing characteristics: The wide distribution, well-defined habitat and distinctive habit, bark and leaves make willow oak one of the most readily identified oaks in the Delta. The one species with which it is likely to be confused, shingle oak (Quercus imbricaria Michaux), is confined to the northern half of the Delta, has somewhat larger, coarser and relatively much broader leaves that have slightly thickened, revolute, frequently undulate and occasionally lobed margins, and stout downy petioles $\frac{1}{4}$ to $\frac{1}{2}$ -inch long. The bark, fruit and winter buds of these two species are somewhat similar. The bark of shingle oak, however, is light brown, not black, and is not so deeply ridged or so rough as that of willow oak. With respect to the winter buds, those of willow oak are characteristically narrowly conical, not angled at all, very sharp-pointed, about $\frac{1}{8}$ -inch long, and dark chestnut brown with well-defined, very pale gray or white edges on the numerous scales, so that each scale is sharply outlined and the bud has a two-colored appearance. Shingle oak buds are also about $\frac{1}{8}$ -inch long and much the same shade of chestnut brown (although usually lighter) but the scales are not edged with gray or white and each bud is of a uniform color with the individual scales very difficult to

WILLOW OAK - Quercus phellos L.

distinguish. The buds are also broader and more ovate than those of willow oak and are usually more or less angled.

Economic considerations: Due to its wide distribution and fair accessibility, willow oak is of considerable commercial importance. Its average quality, however, is only fair and locally it is often extremely poor, which makes it of considerably less importance than it might otherwise attain. It nevertheless makes up an appreciable part of the red oak of commerce.

Willow oak is of only average susceptibility to fire injury, and fungus damage is usually light. However, grub damage, especially on poor sites, is usually very severe and willow oak is probably more often shaky than any other oak except overcup oak. The bole usually has numerous small adherent limbs, especially on poor sites; and second or higher logs generally have numerous unsound and black knots.

The heartwood is reddish-brown and the rather wide sapwood is grayish or somewhat yellow. The grain is usually, but not uniformly, good. The wood checks less severely than that of most others of the water oak sub-group. The rate of growth is usually only medium but on good sites and in open stands it is extremely rapid.

Willow oak is used like other oaks in a great variety of forms but because of its average grade and texture it is most commonly used for small cutting and low-grade purposes and for flooring. The tree is usually cut for lumber on almost all good sites but not infrequently is cut entirely for ties. Its accessibility, its mixture with better species and its usually long bole make it a suitable species for tie operations. On poor sites entire stands are sometimes left uncut because the quality is consistently too low for lumber. In parts of Arkansas especially, overmature willow oak stands are regularly

WILLOW OAK - Quercus phellos L.

passed up on sight because the trees are so uniformly shaky, grubby and mineral-stained. In Louisiana such poor stands are not very common. There is evidently a strong relation between site and quality of timber. The quality of willow oak is most variable in second bottoms where it occurs on several different sites; on clay ridges in first bottoms it is rather uniformly of good quality and usually somewhat better than the associated Nuttall oak.

WILLOW OAK - Quercus phellos

LAUREL OAK - Quercus laurifolia Michaux

Name in use in the Delta: Laurel oak.

Distribution and habitat in the Delta: Laurel oak possibly occurs on the eastern margin of the Delta in southern Louisiana. It is a Gulf Coast species that is rarely abundant anywhere and more or less confined to banks of streams, the edges of swamps, small branch bottoms in the coastal piney woods, etc. If it does occur in the Delta, it is undoubtedly present only along the eastern edge adjacent to the lower Gulf Coastal Plain in Louisiana.

Forest types in which most commonly found, and most common associates:

Nothing definite is known of its occurrence in the Delta.

General appearance: Laurel oak is a small to medium-sized tree with a tall, fairly straight trunk and rather slender branches that form a dense, rounded crown. The leaves are usually elliptic and acuminate at the ends, but occasionally lanceolate and rounded or even 3-lobed at the apex and often variously lobed on young trees. They are thin, very lustrous green above, lighter below, usually 3 to 4 inches long by about $\frac{3}{4}$ -inch wide, with a prominent yellow midrib and short, stout petioles. The leaves remain on the trees to within a few weeks of the unfolding of the new leaves in spring. The acorns are short (about $\frac{1}{2}$ -inch long), ovoid to hemispheric, dark brown and enclosed for about one-fourth of their length in a thin saucer-like cup.

Distinguishing characteristics: Laurel oak, if found in the Delta, could be mistaken only for live oak (Quercus virginiana Miller) and possibly water oak (Quercus obtusa Ashe). The principal differences with respect to live oak are given under the latter species. The outstanding difference between laurel oak and water oak (Quercus obtusa Ashe) is that whereas the leaves of both have about the same length (3 to 4 inches), those of laurel oak average only $\frac{3}{4}$ -inch wide

LAUREL OAK - Quercus laurifolia Michaux

and those of water oak average $1\frac{1}{2}$ inch wide. Water oak leaves are thus about twice as wide as those of laurel oak, and since the length of either is not very great this difference is readily perceived.

Economic considerations: Laurel oak can be used for lumber but is rarely suitable for cutting and is not preferred."

LAUREL OAK - Quercus laurifolia Michaux

SHINGLE OAK - Quercus imbricaria Michaux

Names in use in the Delta: Shingle oak, pin oak.

Distribution and habitat in the Delta: Shingle oak is one of the most common oaks of the lower Ohio River basin but it ranges into the Delta only in the northern half. Specimens may be found as far south as southern Arkansas or northern Louisiana but most of the Delta shingle oak occurs in the most northern parts of the region. The species is most commonly found on the low-lying very moist sites favored by willow oak and pin oak. It thus occurs principally on flats, but it is by no means uncommon on rich moist soils on ridges, or on rich hillsides outside the bottoms. From central Arkansas southward it is of extremely scattered and irregular occurrence.

Forest types in which most commonly found, and most common associates: Shingle oak is found principally in the oak-hickory type on very moist flats and in the willow oak, loblolly pine-hardwood and willow oak-cherrybark oak-cow oak types. It is locally a common species in these types in the northernmost parts of the Delta but is probably never predominant.

Its most common associates are willow oak, pin oak and overcup oak, winged and American elms, ash and terrace hickories (perhaps especially nutmeg and shagbark).

General appearance: Shingle oak is ordinarily only a medium-sized tree, rarely over 80 feet tall. It develops a straight, tall, clear trunk and a narrow, round-topped crown containing many slender horizontal or drooping branches. The bark is close, light brown or grayish-brown, and shallowly fissured into broad low ridges. The leaves are narrowly oblong, 4 to 6 inches long by $\frac{3}{4}$ to 2 inches wide, either acute or rounded at either end, with slightly thickened, revolute, frequently undulate and occasionally lobed margins, and

stout downy petioles about $\frac{1}{4}$ to $\frac{1}{2}$ -inch long. The leaves are thin but firm and tough, smooth, very dark green and very lustrous above, paler or brownish and pubescent beneath.

Distinguishing characteristics: Because of its distinctive leaves and its limited range in the Delta, shingle oak will rarely be confused with other species. The one tree with which it might be confused, willow oak (Quercus phellos L.), can readily be separated from it on the basis of bark, leaves or winter buds. The differences in these organs are described in detail in the section on willow oak.

Economic considerations: Little can be said of the peculiar characteristics and utilization of shingle oak but it is undoubtedly cut rather indiscriminately when of lumber size and quality. The lumber probably gravitates to the medium and lower grade uses on the basis of grade alone. The principal secondary utilization is probably for cross-ties.

LIVE OAK - Quercus virginiana Miller

Name in use in the Delta: Live oak.

Distribution and habitat in the Delta: Live oak is a tree of the southern coastal plain and in the Delta region is found only in the southernmost part, along the Gulf Coast (except, of course, where planted). Here it occurs on the borders of tidal marshes and in hammocks, adjacent to rather than entirely within the main alluvial area.

Forest types in which most commonly found, and most common associates:

Live oak occurs in only one of the generally distributed Delta bottomland hardwood types and otherwise entirely in a unique type of its own which may be called the live oak type. Here it is usually the outstanding species and is generally associated with water (nigra) oak, red gum and yaupon (Ilex vomitoria Ait.). The other type referred to is a peculiar red gum-loamy ridge oaks type in which water (nigra) oak is most prominent and cherrybark oak, red gum and cow oak are occasional to common. American elm, black gum and holly (Ilex opaca Ait.) are also usually present.

General appearance: Live oak has a distinctive, stout, short trunk and a very wide-spreading crown of stout, long, horizontal or drooping branches. The trunk is frequently swollen and buttressed at the base. The tree is never very tall (rarely over 60 feet) but the trunk is often of great diameter (up to 6 to 8 or even 10 feet). Live oak is one of the outstanding scenic and picturesque features of the southern coastal plain. The bark is medium to dark brown or almost black (especially on the butt), thin, and irregularly divided into close, narrow broken ridges. The leaves are small, 2 to 5 inches long by $\frac{1}{2}$ to $2\frac{1}{2}$ inches wide, very dark green, waxy and lustrous above, pale and downy beneath, with entire and slightly revolute margins (or rarely some-

LIVE OAK - Quercus virginiana Miller

what toothed with small spine-like teeth above the middle), oblong, and evergreen. The fruit is a lustrous, dark brown, ovoid to ellipsoidal acorn, about 1 inch long and one-third as wide, enclosed for one-fourth to one-third of its length in a thin cup borne on a stout stalk that is 1 to 5 inches long. Each stalk carries from 1 to 5 (usually 3 to 5) acorns clustered at its end.

Distinguishing characteristics: Live oak is almost never confused with other oaks. Laurel oak (Quercus laurifolia Michaux) is somewhat similar but is not evergreen, has short, ovoid or hemispherical acorns and the margins of the leaves are not revolute.

Economic considerations: At the present time, live oak is of very small commercial importance. It was once an important source of timber for ship-building, hubs, special carving and cabinet work and had little competition from other woods. It is still occasionally used for such specialties but the timber is not marketed through the regular hardwood lumber channels. A few small special operations supply the limited market. On the whole, it is very rarely cut except in land clearing or reclamation operations.

Live oak is a thrifty, hardy tree that has no special defects or unusual susceptibility to any form of injury. The wood is extremely dense, hard, heavy, difficult to cut, and has a distinctive dark brown color.

LIVE OAK - Quercus virginiana Miller

WHITE OAK - Quercus alba L.

Names in use in the Delta: White oak, forked-leaf oak (most commonly used).

Distribution and habitat in the Delta: White oak occurs throughout the Delta with the probable exception of the southernmost part of Louisiana. It is typically found on upland sites in mixture with other hardwoods and often with loblolly pine, and is by no means a typical bottomland species. It probably never occurs in first bottoms, and in second or higher bottoms it is restricted to the higher, loamy, better-drained ridges where it is locally common. It is much more common in the Delta region of Arkansas, principally because of the greater area of suitable second bottoms, than in the Delta regions of Louisiana and Mississippi.

Forest types in which most commonly found, and most common associates: White oak occurs in the bottoms almost entirely in three types: the oak-hickory, red gum-loamy ridge oaks and loblolly pine-hardwood types. In each of these, especially in the first two on suitable second bottoms, white oak is infrequently a major associate, often a minor associate. Its distribution is very local and irregular, however, and on many apparently favorable sites there is no white oak at all.

Its most common bottomland associates are red gum, black gum, cow oak, water (nigra) oak, post oak, cherrybark oak, southern red oak, winged elm, terrace hickories and, locally, loblolly pine.

General appearance: White oak is a medium-sized to large tree, in the bottoms rarely attaining a height of 120 to 150 feet with a d.b.h. of 3 feet or more. It develops a straight, tall, relatively slender, clear trunk and a long,

WHITE OAK - Quercus alba L.

relatively narrow crown of very stout and very numerous branches. The bark is brownish-gray to silvery or very pale gray, very thick on old trunks, and separated into rather loose, irregular, rough, scaly, flat ridges and rough, shaggy plates. The long, broad plates on mature trunks are typically loose along one edge and usually also at one or both ends. The upper trunk and large limbs have also a rough, shaggy, platy bark. On small trees the bark is divided into small platy or flaky ridges. The leaves are thin, firm, smooth on both surfaces, bright green above, somewhat paler beneath, 5 to 9 inches long by 2 to 4 inches wide, and may be either deeply (typically) or shallowly cleft into 7 to 9 obliquely ascending, blunt lobes. The leaves are obovate-oblong, usually slightly widest above the middle and taper to a wedge-shaped base and stout, smooth petiole, $\frac{1}{2}$ to 1 inch long. The fruit is an ovoid-oblong, lustrous light chestnut-brown acorn, about $\frac{3}{4}$ -inch long and half as wide, enclosed to about one-fourth of its length in a moderately deep bowl-like cup.

Distinguishing characteristics: White oak is rarely confused with other oaks. Possible confusion with post oak is discussed in the section on post oak. White oak may also be confused with cow oak (Quercus prinus L.) because the two trees often occur together and there is a strong, though usually superficial, resemblance in bark habit. Cow oak bark is slightly browner or redder than that of white oak and on mature trunks cow oak bark is usually divided into a number of rough, irregular scales or indistinct, usually narrow, closely-appressed, scaly ridges (or into distinct, firm, narrow ridges in northern Arkansas) rather than into definite, long, broad, rough, rather loosely attached plates or platy ridges. However, the bark of white oak is occasionally indistinguishable from that of cow oak, in which case it is necessary (and in all cases highly desirable) to compare the leaves, acorns and winter buds. These are all very

WHITE OAK - Quercus alba L.

different in the two species. White oak leaves are bright green above, not lustrous, only slightly paler beneath, and their margins are definitely and usually deeply lobed. Cow oak leaves are dark green and lustrous above, much paler or silvery beneath, and their margins are definitely and regularly toothed (with coarse, rounded teeth). White oak acorns are rarely over $\frac{3}{4}$ -inch long and are relatively narrow; cow oak acorns are usually 1 to $1\frac{1}{2}$ inch long and are plump and relatively broad. White oak buds are essentially smooth and rarely over $\frac{1}{3}$ -inch long; cow oak buds are decidedly hairy and usually $\frac{1}{4}$ -inch long.

Economic considerations: White oak is an outstanding timber species in the country as a whole but is of comparatively little importance in the Delta bottoms, except from southern Arkansas northward, because of its general scarcity and comparatively poor average quality. It is generally cut for lumber in the Delta wherever suitable trees are found but because of its usual occurrence close to agricultural areas it is often more commonly cut for fuel and posts for farm use.

In the southern part of the Delta, white oak is unusually subject to pin knots, grubs and bird peck, and is generally rather unthrifty and poorly-developed compared to its usual habit of growth elsewhere. However, in certain parts of the Delta (e.g., West Carroll Parish, Louisiana, and certain localities in Arkansas) white oak is occasionally as fine a tree as it ever becomes anywhere in the country. On the better sites it is generally satisfactory for lumber.

White oak was long considered the finest possible wood for tight cooperage, ship, bridge, and dock timbers and ties as well as for industrial lumber. In recent years, however, the rapidly diminishing supply of virgin

WHITE OAK - Quercus alba L.

white oak has caused it to fall back somewhat from its peak of predominance so that now it is considered merely one of the better oaks of the white oak group. It now goes largely into factory lumber (including flooring) and ties, according to quality and circumstances. Utilization in the Delta is not usually very close.

WHITE OAK - Quercus alba L.

POST OAK - Quercus stellata Wang.
and/or a variety and/or Quercus mississippiensis Ashe

NOTE: The tree described below is probably not the true Quercus stellata Wang. but in the absence of sufficient taxonomic study it seems best to call it "post oak". It closely resembles Quercus stellata Wang. in most respects (with the striking exceptions of size, quality and habitat) and if not a variety is at least a very closely allied new species, viz., Quercus mississippiensis, described by W. W. Ashe in "Notes on Magnolia and Other Woody Plants", Torreya, 31: 37-41, March-April, 1931.

Name in use in the Delta: Post oak.

Distribution and habitat in the Delta: Post oak occurs throughout the Delta region but is found principally in second bottoms, where it is most common on washboardy and hummocky topography but also occurs on low, heavy loamy ridges and high flats. It is probably most common, as well as of its finest development, in the second and higher bottoms of West Carroll Parish, Louisiana, where it is frequently an outstanding species on the hummocky silt loam soils of Macon Ridge. Ordinarily, however, post oak is by no means a prominent tree, but merely one that on favorable sites is a widely-distributed minor associate, occasionally becoming a chief associate. Post oak is very rarely found on clay soils, preferring a heavy loamy soil with an abundant supply of moisture. Its sites are often slowly drained but not usually poorly drained.

Forest types in which most commonly found, and most common associates:

Post oak occurs in a number of bottomland types but only the six principal types need be mentioned here. They are the willow oak-cherrybark oak-cow oak, oak-elm-ash (almost entirely in second bottoms), oak-hickory, loblolly pine-

POST OAK - Quercus stellata Wang.

hardwood, red gum-loamy ridge oaks (rarely) and willow oak (rarely).-- The tree is most common and usually best developed in the first-named type.

Its most common associates are cherrybark, water (nigra), willow, cow and white oaks, red gum, black gum, American and winged elms, white ash, terrace hickories and loblolly pine. In the bottoms, it is probably the oak most frequently found with loblolly pine.

General appearance: At its best the bottomland post oak develops a tall, straight, massive trunk with a broad, open crown of stout branches and branchlets. In West Carroll Parish, Louisiana, it often reaches a height of 100 to 110 feet, with a d.b.h. of 3 feet or more, but ordinarily it is only a medium-sized tree. The trunk is generally straight and only rarely twisted. The bark of mature trees is grayish-brown, often with a silvery cast, very thick and deeply divided by rather regular, long, narrow, angular ridges which are much cross-checked and scaly or platy on the surface. Freshly-cut surfaces are dull yellowish-brown. The leaves are very harsh and coarse, thick, stiff, very dark lustrous green above, very pale-grayish or silvery beneath, roughened above by scattered coarse hairs and beneath by dense, velvety down or scurf. The leaves are rather small (4 to 7 inches long by 2 to 4 inches wide), relatively broad, deeply divided into 3 to 7 (most often only 3) rounded lobes that frequently give the leaf the form of a cross, broadest just above the middle and tapering to a narrow, rounded or wedge-shaped base. The petioles are stout, downy and $\frac{1}{2}$ to 1 inch long. The fruit is an oblong-ovoid acorn, $\frac{1}{2}$ to 1 inch long and about two-thirds as wide, enclosed for one-fourth to one-half of its length in a moderately deep to shallow, thin cup.

Distinguishing characteristics: The bottomland post oak usually bears no close resemblance to other Delta oaks but small trees are occasionally

POST OAK - Quercus stellata Wang.

confused with small specimens of overcup oak. There are many differences between these two, however, and they are fully discussed in the section on overcup oak. Post oak is rarely (and quite inexcusably) confused with white oak (Quercus alba L.). White oak bark is silvery gray and divided into broad, rather loose flakes or plates; it is never decidedly brown and divided into narrow firm ridges as in post oak. White oak leaves are thin, smooth to the touch, bright green above and not at all lustrous; those of post oak are thick, harsh and rough to the touch, and very dark lustrous green above. White oak branchlets are pale, slender, perfectly smooth and usually lustrous; those of post oak are dark, comparatively stout, rough, often scurfy and dull. In the spring, the unfolding young leaves of white oak are pinkish-red, downy and soft; those of post oak are deep red, orange or yellowish-brown, downy and rather firm and stiff.

Economic considerations: Post oak is of secondary to minor importance in the Delta, except locally as in West Carroll Parish, Louisiana. Its total cut probably approximates that of overcup oak. It is usually cut for lumber wherever suitable trees are found. On very poor sites, principally on uplands where the true Quercus stellata Wang. occurs, post oak is fit only for railroad uses, posts and fuel.

It must be kept in mind that the post oak or bottomland post oak (of uncertain species) found largely on good sites in the Delta bottoms is an entirely different tree, from the economic viewpoint, from the true post oak (Quercus stellata Wang.) which may or may not occur on second or higher bottoms in the Delta but which does occur abundantly on poor upland sites within or bordering the Delta region. The quality of post oak is definitely correlated with site and the different sites probably support different species or varieties.

POST OAK - Quercus stellata Wang.

Post oak is generally very free of injury or defects on its best sites

but on poor sites grubs and spot worms are common and serious causes of de-

fect. The wood frequently has bad pin knots, bird peck and mineral stain.

Crossed or spiral grain is also occasionally found. These defects are usually not serious on good sites but are very prominent on poor sites.

The wood is rather brittle and flinty, although it is generally easy to split. Freshly-cut surfaces are a rich golden brown, rarely somewhat pink in the best logs. Only the very best specimens occurring on the good sites are thoroughly suitable for lumber. Utilization is moderately close in good stands but in poor stands the logs are usually carefully selected and the utilization is necessarily far from close.

Names in use in the Delta: Burr oak, mossy-cup oak, overcup oak (?).

Distribution and habitat in the Delta: Burr oak has a very wide range in North America (concentrated especially in the Lake, Central and certain of the Prairie states) but is found in the Delta only from about central Arkansas northward (although one or two specimens have been reported from central Louisiana). Within this limited range it is fairly well distributed in both first and second bottoms but only locally common. Burr oak is found on both flats and ridges but is most common on moist flats and on washboardy or hummocky topography. It can and frequently does grow on dry sandy or gravelly uplands, but its best development is on deep, moist, loamy flats or at the bases of ridges.

Forest types in which most commonly found, and most common associates:

Burr oak occurs in the Delta principally in the willow oak-cherrybark oak-cow oak, oak-elm-ash, red gum-clay land oaks, oak-hickory (mainly on moist flats) and southern cypress-hardwood types. It is probably never predominant and rarely more than a minor associate. Locally, especially in the northernmost part of the Delta, it may occur in small groups; otherwise its occurrence takes the form of scattered single trees.

Its most common associates are pin, willow and overcup oaks; American, winged and cedar elms; terrace hickories; and red and silver maples.

General appearance: Burr oak at its best is one of the largest of North American oaks but in the Delta it probably does not often even approach its maximum size, said to be 7 feet d.b.h. and 170 feet high. It is nevertheless a medium to large sized tree. It develops a massive, tall, clear trunk and a

broad, open crown of stout branches. The stout branchlets are pale orange during their first season, later becoming dark brown and occasionally developing corky wings. The bark of mature trees is thick, brown or reddish-brown, divided by deep furrows into prominent ridges covered with hard, closely-appressed plates or scales. The leaves are large (6 to 12 inches long by 3 to 6 inches wide), thick, dark green and lustrous above, paler or silvery white and very downy beneath, tapering sharply from a broad apex to a narrow wedge-shaped base, usually deeply divided into 5 to 7 irregular lobes, the terminal the largest, with irregular crenate margins. At least a few leaves on each tree are generally cleft almost to the midrib by two deep, wide, rounded, opposite sinuses at about the middle of the blade. Some leaves are very shallowly cleft and merely have wavy or crenulate margins. The fruit is unique: a large, plump, chestnut-brown acorn, often 2 inches long, downy at the apex, and enclosed from one-half to all of its length in a deep bowl-shaped cup that has a moss-like fringe of hairs at its rim.

Distinguishing characteristics: The leaves and fruit are so distinctive that burr oak is very easily identified. They resemble the leaves and fruit of no other Delta oak. In winter the massive trunk and broad crown of stout branches, with their pale orange branchlets of the current year, are also characteristic. Since no Delta oak is at all likely to be confused with burr oak, no detailed comparisons with other species seem necessary.

Economic considerations: The wood of burr oak is much the same as that of white oak but somewhat harder and darker in color and the trees are not of such high average quality. For these reasons the wood of burr oak possibly gets into use as railroad and structural material rather more than that of white oak. It is, however, highly regarded and used grade for grade much the same as white oak. It is probably not as good a veneer timber.

BURR OAK - Quercus macrocarpa Michaux

OVERCUP OAK - Quercus lyrata Walter

Names in use in the Delta: Overcup oak, swamp post oak, swamp white oak.

Distribution and habitat in the Delta: Generally distributed throughout the South, overcup oak is especially common in the Delta region. It ranges throughout the Delta but is largely confined to poorly-drained areas. It is most abundant on low-lying tight clay flats in first bottoms where it frequently is the predominant species. Overcup oak is also common on the edges of swamps, sloughs and bayous; in poorly-drained depressions, pockets or sink holes on ridges; and in shallow swamps and sloughs. It is more common in first than in second bottoms and is not infrequent on fairly well drained clay ridges subject to overflow. Any low area in the bottoms that receives abundant moisture and has poor or very poor drainage is a potential, if not an actual, site for overcup oak.

Forest types in which most commonly found, and most common associates:

Overcup oak is usually a dominant species only in the overcup oak-water hickory type. It is, however, an important associate in many other bottomland types where it is almost always found and where it is occasional to common, often occurring in groups that are locally dominant. These include the red gum-clay land oaks, willow oak-cherrybark oak-cow oak, hackberry-elm, oak-elm-ash, southern cypress-hardwood and willow oak types.

The most common associates of overcup oak are water hickory, persimmon, green ash, willow oak, Nuttall oak, hackberry, American elm, cedar elm, water oak (Quercus obtusa Ashe), honey locust and water locust.

General appearance: Overcup oak is ordinarily of medium size, rarely over 3 feet in d.b.h. or as much as 100 feet high. It develops a short trunk,

OVERCUP OAK - Quercus lyrata Walter

frequently crooked or twisted spirally, and a broad, wide-spreading, open crown of crooked, torturous branches bearing relatively few branchlets. The trunk is rarely clear for any great length, due to the usual prevalence of small branches or water sprouts and the low height at which the crown begins. The bark of the mature trunk is thick, brownish-gray to grayish-brown, frequently twisted spirally, and divided into very rough, irregular, long, narrow ridges. There are usually large patches from which the ridges seem to have sloughed off, leaving areas of flat, rather closely-appressed, rough scales or plates. The bark of the upper trunk and branches is also very thick and rough. The leaves are rather large (5 to 10 inches long by 1 to 4 inches wide), thin, lustrous dark green and perfectly smooth above, very pale green or silvery and slightly downy beneath, narrowly oblong and relatively long, much narrowed and wedge-shaped at the base, irregularly cleft into 5 to 9 angularly-rounded lobes. Some leaves are deeply lobed, others very shallowly lobed. The petioles are $\frac{1}{4}$ to 1 inch long, thin, and essentially smooth. The distinctive fruit is an almost round, somewhat flattened, light brown acorn, broadest at the base, from $\frac{1}{2}$ to 1 inch long, and from two-thirds to completely enclosed in a deep, round cup with very thick scales at the base. The stalk is slender and hairy and is occasionally over one inch long.

Distinguishing characteristics: Overcup oak is readily identified at any season of the year. Its habitat, habit, bark, leaves and fruit are all very distinctive. It is occasionally mistaken for post oak (Quercus stellata Wang. and/or its common bottomland variety and/or Quercus mississippiensis Ashe), especially when the trees in question are small. There are many sharp differences, however. Because of the frequently close resemblance between young specimens of the two species with respect to bark, positive identification based on bark

OVERCUP OAK - Quercus lyrata Walter

alone is difficult. On large trees the bark of overcup oak is so much browner, rougher, more patchy and so frequently spirally twisted, that it is rarely confused with the silvery grayish-brown, more regularly ridged bark of post oak. For all sizes of trees, however, the leaves, branchlets and fruit are always distinctive. Overcup oak leaves are thin, firm, and feel smooth on both sides (although actually slightly downy beneath); post oak leaves are thick, coarse, stiff and feel harsh and rough on both sides. Overcup leaves average 6 to 8 inches long, are relatively long and narrow, the lobes hardly ever give the leaf the shape of a cross, and the base is practically always very narrowly wedge-shaped. Post oak leaves average 4 to 6 inches long, are relatively short and broad, the lobes commonly give the leaf the form of a cross, and the leaves are generally quite rounded and not unusually narrowed at the base. Overcup oak leaves turn dull yellow, yellow-brown, or light brown before falling; post oak leaves turn light to dark red or reddish-brown before falling. Petioles of overcup oak leaves are slender and practically smooth, those of post oak leaves are stout and downy or scurfy.

Overcup oak branchlets are slender and essentially smooth; post oak branchlets are stout, usually distinctly roughened and often scurfy. Small post oak branches are considerably rougher and shaggier than those of overcup oak. The round or broader-than-long acorn of overcup oak is more or less completely buried in a deep, round cup. Post oak acorns are oblong-ovoid, definitely longer than broad and enclosed only for about one-fourth to one-half of their length in shallow or only moderately deep cups.

Economic considerations: Although overcup oak has always been rather diligently avoided or passed up by most loggers and lumbermen, it has never

OVERCUP OAK - Quercus lyrata Walter

been either possible or practicable to disregard it entirely and it has long been more or less well known on the market. It is becoming a rather staple item in the lumber trade at the present time, largely through force of circumstance or economic pressure.

Overcup oak is extremely susceptible to grub infestations, shake and mineral streaks. Within the past few years a leaf skeletonizer has badly damaged many stands in southern and central Louisiana. Fire damage in itself is not unusually severe but it generally prepares the way for greater pin worm infestations than in other species. Overcup oak is not unusually susceptible to other forms of injury but it generally has a short bole and heavy crown and frequently develops numerous small adventitious limbs. Logs are very apt to be full of pin knots and bird peck. The wood also checks rather badly, warps more than any other oak and is often spirally grained but in spite of all these usual defects a good class of logs can generally be selected on all but the very poorest sites. Unfortunately the species is most common and often predominant on the poorest sites, where its quality is consistently extremely low.

Some operators still discriminate against overcup oak and never cut it at all, but ordinarily logs are cut wherever they can be carefully selected. Its chief use is for lumber. It is not suitable for railroad material because of its checking and its loose hearts, but a small quantity is used in that way. With the rapid disappearance of good white oak timber, overcup oak is being used more and more for tight staves. Utilization is almost always, and necessarily, far from complete no matter what product is taken.

The above discussion applies particularly to the southern half or two-thirds of the Delta. At and north of the latitude of Memphis, overcup oak is probably fairly comparable to burr oak with respect to quality and commercial use.

OVERCUP OAK - Quercus lyrata Walter

COW OAK - Quercus prinus L.

(Swamp chestnut oak in Sudworth)

Names in use in the Delta: Cow oak, white oak, basket oak.

Distribution and habitat in the Delta: Cow oak is distributed throughout the Delta but is of rather local and irregular occurrence. It occurs principally on loamy washboardy and hummocky sites and secondarily on low flat-topped loamy ridges. It probably never occurs on clay soils but always on loamy soils. Where it occurs at all, it is frequently the outstanding species. It is principally a tree of second bottoms and the outer margins of first bottoms. Abundant moisture is required and its favorite sites (washboardy and hummocky) are either overflowed more or less regularly by small local streams or, more commonly, subject to shallow sheets of standing water for short periods in the late fall and winter. Such sites are never really poorly drained but the drainage may often be slow.

Forest types in which most commonly found, and most common associates:

Cow oak occurs principally in the oak-hickory and willow oak-cherrybark oak-cow oak types where it is very irregular and local in its occurrence, yet usually abundant or predominant where present at all. It also occurs to some extent, but is rarely common, in the red gum-loamy ridge oaks and oak-elm-ash types.

Its most common associates are red gum, cherrybark oak, willow oak, water (nigra) oak, American elm, winged elm, white ash and black gum. Blue beech is often a common species in the understory.

General appearance: Cow oak is a moderate to large-sized tree, usually developing a stout, massive, straight trunk and a relatively narrow crown of stout branches. The bark is medium to pale or silvery gray, generally with a

COW OAK - Quercus prinus L.

rownish or reddish cast, rich reddish-brown on freshly-chipped surfaces and usually divided into rather narrow, irregular, indistinct scaly or platy ridges with rough or shaggy surfaces. The ridges and plates are rather firmly attached and not usually loose at the edge. In northern Arkansas cow oak bark is commonly broken into prominent, firm silvery gray, narrow longitudinal ridges by deep narrow fissures. The ridges are scaly on the surface but not platy or shaggy. The leaves are firm, very dark green and lustrous above, very pale or silvery beneath, about 6 to 8 inches long by 3 to 5 inches wide, widest above the middle and sharply tapered to a broad pointed apex and a narrow wedge-shaped base, and the margins are regularly and coarsely toothed with rounded teeth. The fruit is a large, plump, lustrous brown acorn 1 to $1\frac{1}{2}$ inch long by $1\frac{1}{4}$ inch wide and enclosed for not over one-third of its length in a fairly deep, flat-bottomed cup.

Distinguishing characteristics: Cow oak is a distinctive tree and not often confused with other Delta oaks. Its bark often closely resembles that of white oak but there are no other close resemblances between the two. Their distinguishing characteristics are described in the section on white oak. Cow oak is most apt to be confused with chinquapin oak (Quercus muehlenbergii Engelm.), the occurrence of which within the Delta is not well known beyond the fact that it is not common and probably confined to the northern half. There are several sharp differences between these two species, however. Chinquapin oak leaves are more narrow, are a much paler and more yellowish-green in color, and have finer and sharper teeth than those of cow oak. Moreover, the teeth on chinquapin oak leaves usually have incurved points, quite unlike the plain points of the cow oak leaves. The fruit of chinquapin oak is an acorn rarely as much as 1 inch long and about half as wide (thus shorter and much less plump than that of cow oak) that is enclosed for one-third to one-half of its length in a

COW OAK - Quercus prinus L.

relatively deep cup (thus more deeply enclosed than that of cow oak). The bark of the two trees is rather similar but that of chinquapin oak is more definitely ridged. The trunk of cow oak is almost always cylindrical or only slightly tapered at the base, that of chinquapin oak often broad and buttressed at the base. Finally, chinquapin oak probably always occurs on higher and drier sites in the Delta bottoms than does cow oak and the two are rarely if ever found together.

Economic considerations: From the standpoint of commercial value, cow oak was long the most important common hardwood in the Delta, at least below southern Arkansas, because it took the place of white oak. Although its increasing scarcity has recently permitted other species to take first rank, cow oak is still a very important oak and one of the very best with respect to quality.

Cow oak timber is unusually sound, clear and dependably uniform. Its chief defect is a tendency toward sap limbs above the first log. Bird peck is occasional. Otherwise, cow oak is unusually free of injury or defect. It does not usually produce an extraordinarily high percentage of the highest grade material but it does very regularly produce a relatively great amount of #1 Common and it usually cuts out as well as it looks. Hidden defects are not at all common.

Cow oak was surpassed as a stave timber only by white oak and then only because of the wider distribution of the latter species. An immense volume of cow oak was exploited for staves before sawmills ever entered the southern part of the Delta. Cow oak was also quarter-sawed very largely when taken to the mill. At present it is used for the same general products as other oaks. Because of the nature of the wood and the usual grade of lumber that it

COW OAK - Quercus prinus L.

roduces, cow oak is now probably used largely for furniture and fixture work.
t is well adapted to use as ties, posts and large timbers but is not often
used for such products, or at least not to the extent that white and post oaks
re so used.

Between the lumber industry, the stave industry and farmers, cow oak
s very heavily cut and the exploitation is often great enough to prevent the
evelcpment of satisfactory reproduction.

COW OAK - Quercus prinus L.

CHINQUAPIN OAK, - Quercus muehlenbergii Engelman.

Names in use in the Delta: Chinquapin oak, yellow oak, chestnut oak.

Distribution and habitat in the Delta: Chinquapin oak is very uncommon in the Delta bottoms, except possibly in the northernmost part where it is close to its region of optimum development--southern Indiana and Illinois. South of central Arkansas, chinquapin oak is very rare in the bottomlands but not uncommon on the uplands. North of central Arkansas it is occasional or locally common in the bottomlands and rather generally common on the uplands. In the Delta bottoms chinquapin oak is probably confined to the higher and better-drained ridges in second or higher bottoms.

Forest types in which most commonly found, and most common associates:

It is probable that this species occurs only in the oak-hickory, red gum-loamy ridge oaks and loblolly pine-hardwood types, especially in the first-named. Its most common associates are probably terrace hickories, white oak and black oak.

General appearance: Chinquapin oak is a medium to large-sized tree and develops a tall, straight trunk, often broad and buttressed at the base, and a relatively narrow crown of comparatively small branches. The bark is rather thin, pale gray and divided into rather loose, scaly or platy ridges. The leaves are generally narrowly oblong, thick, firm, pale yellow-green above, very pale or silvery and downy beneath, 4 to 7 inches long by 1 to 5 inches wide, with margins regularly and finely toothed with rather sharply rounded, usually incurved teeth. The leaves are usually slightly widest at about the middle and taper each way to a usually narrowed, wedge-shaped apex and base. The fruit is a light brown, ovoid acorn, $\frac{1}{2}$ to rarely 1 inch long

CHINQUAPIN OAK - Quercus muehlenbergii Engelman

and half as wide, enclosed for one-third to one-half of its length in a thin, relatively deep cup.

Distinguishing characteristics: Chinquapin oak is apt to be confused only with cow oak. The distinction between the two species is discussed in the section on cow oak. The bark of chinquapin oak often strongly resembles that of white oak but the leaves are so different that the trees are not usually confused.

Economic considerations: The wood and its uses are comparable to those of white oak but very little is known of its exploitation in the Delta.

THE ELMS - Ulmus L.

Three species of elm are common in the Delta bottomlands. Their occurrence, habitat, distinguishing characteristics and utilization are presented in tabular form for convenience in comparison.

Basis for Comparison	American Elm <u>Ulmus americana</u> L.	Winged Elm <u>Ulmus alata</u> Michaux	Cedar Elm <u>Ulmus crassifolia</u> Nuttall
Names in use in the Delta	<u>White elm</u> , <u>red elm</u> , <u>gray elm</u> , <u>water elm</u> , <u>soft elm</u> .	Winged elm, cork elm, rock elm.	<u>Rock elm</u> , cedar elm.
Range in the Delta	Throughout the Delta.	Probably throughout the Delta.	Probably only from central Arkansas southward.
Distribution and habitat in the Delta	Much more widely distributed than the other two elms; found in both first and second bottoms but especially common in the former. Occasional to common (and in cut-over stands sometimes predominant) on practically all flats, hummocky lands and clay ridges in the first bottoms. Rare to occasional on loamy second bottom ridges, hummocky lands and flats. Common in swags, drains and shallow swamps. Much more apt to be found in standing water than the other two elms and will grow in deeper, longer sustained standing	Confined almost entirely to second bottoms where it is very widely distributed but most common on very moist loamy flats, hummocky lands and low ridges. Often predominant or at least second in abundance on cut-over second bottom flats and at least occasional on practically all second bottom sites. Probably never normally associated with standing water except in the form of intermittent pools and shallow sheets after heavy winter rains.	Widely distributed and found in both first and second bottoms but especially common in the former. Occasional to common (and in cut-over stands often predominant) on most flats, hummocky lands and clay ridges in first bottoms (not so widely distributed as <u>U. americana</u> but where present at all frequently more abundant). Practically never found on loamy ridges but usually occasional on loamy flats in second bottoms. Probably never grows where standing water is deeper or more permanent than on low, tight clay flats shallowly to moderately covered with water during the winter.

Habit (of stem, crown and branchlets) (cont'd)	the comparatively infrequent, well-defined branchlets are at once seen to be very distinctive. The branchlets are more or less roughened but only in very rare instances bear small corky wings.	The branchlets generally bear abundant prominent corky wings, but occasionally wingless or practically wingless trees are found.	branchlets are very rough and generally bear corky wings.
Bark habit	Two types: (1) Rather thin, brownish to ashy gray, broken into irregular low, flat scaly or platy ridges (most common on the lower, wetter flats). (2) Thick, grayish brown to brownish or ashy gray, divided by deep fissures into prominent, thick, fairly broad, longitudinal ridges with flat, rough, fine-scaly surfaces (most common on the better-drained sites).	Very thin, light grayish or silvery brown, shallowly fissured into long, narrow, flat-topped, scaly-surfaced ridges. Never even slightly resembles platy type (1) of <u>U. americana</u> and differs from ridged type (2) in being a paler, more silvery brown, much thinner, with lower, flatter, smoother ridges. The difference, hard to convey by description, is easily recognized in the field.	Fairly thick, very pale purplish or brownish-gray to silvery gray, not ridged at all, but broken into flat, rather small, thin, brittle scales, closely appressed in the middle but loose at the edges. The complete shingling of the fluted, gnarled trunk with gray scales about 1 to 3 inches long by $\frac{1}{2}$ to 2 inches wide, is very distinctive.
Leaves	Alternate, obovate-oblong to elliptic, abruptly narrowed at the apex to a long point, coarsely and doubly serrate, 4 to 6 inches long by 1 to 3 inches wide, smooth or only slightly roughened above, downy below, harsh-textured but only moderately thick, and not unusually stiff or firm.	Alternate, ovate-oblong to oblong-lanceolate, acute but not abruptly narrowed at the apex, coarsely and doubly serrate, 2 to 3 inches long by $\frac{1}{2}$ to $1\frac{1}{2}$ inch wide, smooth above, downy below, harsh-textured, thick, fairly stiff, and firm.	Alternate, ovate to elliptic, acute or rounded at the apex, coarsely and doubly serrate, 1 to 2 inches long by $\frac{1}{2}$ to 1 inch wide, very rough above, downy below, very harsh-textured, thick, stiff and firm.

fruit	A small ($\frac{1}{2}$ -inch long) glabrous, ovoid samara, not much narrowed at either end, ripe in early spring when the leaves unfold.	A small ($\frac{1}{3}$ -inch long) hairy, oblong samara, much narrowed at both ends, ripe in early spring when the leaves unfold.	A small ($\frac{1}{3}$ - $\frac{1}{2}$ -inch long) hairy, oblong samara, moderately narrowed at the ends, ripe in the fall.
Commercial importance in the Delta	Secondary	Minor	Minor
Utilization	Slack cooperage, crating, barrel hoops and thick lumber for medium and low grade furniture and fixtures, auto bodies, toy vehicles, etc. Only the best trees are usually cut for lumber and the utilization is not close.	Same as <u>U. americana</u> but not preferred and seldom cut.	Thick lumber, but there is no established utilization. The tree is often too gnarled and knotty to use for anything, and at best the wood is very hard, not especially tough and is difficult to work. The lumber is usually remanufactured for auto bodies and cheap light vehicles, somewhat like pecan.

Common defects of elm: Sap or pin knots, caused by numerous adventitious branches, frequently reduce the entire contents of an elm log to a box material grade. Bird peck, caused by flecks of bark from sapsucker holes becoming embedded when the wounds are grown over, is often so abundant that it causes the same degrade. Shake, caused by wind, occasionally makes it necessary to throw away the entire middle portion of the log, in extreme cases resulting in loss of one-half of the scale. Spotworm occasionally occurs associated with shake or fire damage.

Odd-shaped, crooked, corrugated and fluted stems and flaringly buttressed butts are also common defects of American elm and cedar elm, especially the former on the wetter sites and the latter on all sites.

THE ELMS - Ulmus L.

Defects are generally easy to recognize and elm logs usually cut out as well as they look.

Source of damage: The elms of the Delta are not particularly subject to damage by insects and fungi and have approximately average resistance to injury by fire.

HACKBERRY - Celtis laevigata Willdenow

(Sugarberry in Sudworth)

Name in use in the Delta: Hackberry.

Distribution and habitat in the Delta: Hackberry is very well distributed throughout the Delta but is very much more common in first bottoms than in second bottoms. It is most frequent on clay flats and low clay ridges in first bottoms and on loamy flats in second bottoms. It is very rare on the higher loamy ridges. On cut-over flats and low clay ridges, especially in first bottoms, hackberry is often predominant; in virgin stands it is usually a very minor species. It will grow on almost any site in the Delta, but appears to do best in low, wet flats.

Occurrence by forest types and common associates: Hackberry is by far the most common and usually predominates in the hackberry-elm type, which is residual after heavy cutting, especially in the red gum-clay land oaks type. Hackberry, like elm, is commonly an overtopped or intermediate tree in virgin stands of the latter type and takes over the site when the overstory is removed. In fact, hackberry is next most common in the red gum-clay land oaks type. It is also common in the overcup oak-water hickory, southern cypress-hardwood, red gum, oak-elm-ash, and willow oak-cherrybark oak-cow oak types in approximately the order given. It probably occurs in each of the other Delta types but usually only as a rare or at best occasional component.

Naturally, hackberry has numerous and varied associates, but the most typical are red gum, Nuttall oak, water oak (Quercus nigra L.), overcup oak, American elm, cedar elm, pecan, water hickory, green ash, honey locust and hawthorn. Hackberry never predominates except in the hackberry-elm type.

General appearance: Hackberry is a small to medium-sized tree with a

HACKBERRY - Celtis laevigata Willdenow

straight but short stem and slender, spreading branches forming a rather broad, open crown. The bark is rather thin, very close, greenish-gray, and characteristically more or less covered with warts and prominent corky excrescences. On some trees these excrescences are two or more inches thick and completely cover the trunk and large branches; on other trees there are very few and the bark is essentially smooth. The leaves are alternate; oblong-lanceolate; acuminate at the apex; average 3 to 4 inches long by about 1 inch wide; are thin, smooth, practically glabrous, practically entire and light green on both sides. The fruit is a small orange or yellow drupe, about one-quarter inch in diameter. The winter buds are very small ($1/16$ to $1/8$ -inch long), ovoid and pointed.

Distinguishing characteristics: Hackberry can hardly be confused with any other Delta species. Its bark alone is absolutely distinctive. It differs from Celtis occidentalis L. (also known as hackberry), which possibly occurs in the Delta in southeastern Missouri, principally in fruit (occidentalis has dark purple drupes, very slightly larger than the orange or yellow drupes of laevigata, and they are borne on pedicels much longer than the petioles as contrasted to laevigata in which the pedicels are shorter or only slightly longer than the petioles); and in leaves (occidentalis has somewhat shorter, broader leaves than laevigata, and they are sharply and finely serrate--either completely or only above the middle).

Economic considerations: Hackberry is not often utilized for lumber but particularly large (usually at least 18 inches d.i.b.), sound and clear logs are cut along with other more valuable species for lumber for cheap furniture and fixtures and for crating. The principal use of hackberry, however, is for slack cooperage and smaller trees, provided they furnish

HACKBERRY - Celtis laevigata Willdenow

and clear bolts, are thus utilized. The wood is soft, weak, not durable, light yellow and has a thick sapwood.

Hackberry is particularly susceptible to fire injury and the rots that begin entrance through fire scars usually develop rapidly. The species reproduces very well.

HACKBERRY - Coltis laevigata Willdenow

RED GUM - Liquidambar styraciflua L.

Names in use in the Delta: Gum, red gum, sweet gum.

Distribution and habitat in the Delta: Common throughout the Delta but much more common in first bottoms than in second bottoms. Most common, probably attaining its greatest size, and often in pure stands, on silty clay or silty clay loam ridges and very moist but not too poorly drained silty clay flats in first bottoms. These sites receive abundant moisture and although the surface soil is generally predominantly clay, the underlying horizons are sufficiently sandy, silty or loamy to give rather good, if somewhat slow, drainage. Next most common on washboardy or hummocky sites in both first and second bottoms and on loamy ridges in second bottoms. Common on old fields in dense, even-aged stands. Uncommon to rare on the lowest, wettest and most poorly drained tight clay flats in first bottoms and usually uncommon on loamy flats in second bottoms (especially where unusually poorly drained and underlain by impervious clays). Very rare, and confined to hummocks, in swamps.

Red gum is undoubtedly the most common and most widely distributed single species in the Delta. It is also common on many upland sites in the South. It will do well on a greater variety of sites than any other species in the Delta. Few hardwood stands in the Delta are without at least a few red gums.

Occurrence by forest types, and most common associates: Most common in the red gum type, and next most common in the red gum-loamy ridge oaks and red gum-clay land oaks types. Red gum is also usually common in the oak-hickory, southern cypress-hardwood, willow oak-cherrybark oak-cow oak and loblolly pine-hardwood types. It occurs in all the other hardwood types but is usually only a minor component.

Red gum is characteristically most closely associated with cherrybark

RED GUM - Liquidambar styraciflua L.

oak on leamy ridges, with Nuttall oak on clay flats and clay ridges, and with cottonwood on old fields. For the host of other common associates, see the descriptions of the types named above.

Stand per acre and types of growth: Stands of pure red gum contain about 75 to 90 per cent red gum by numbers of trees and about 80 to 98 per cent red gum by volume. The stand per acre is heavy and compares favorably with that attained by any other hardwood. Flats usually support somewhat heavier stands than ridges. About 6,000 to 8,000 board feet per acre is average, but 10,000 to 12,000 is not at all uncommon. Unusually good tracts of red gum run 15,000 to 20,000 board feet per acre over an area of several hundred acres, and selected small areas will reach 30,000 to 40,000. Few if any other hardwoods in this country occur in such heavy stands over such large areas, although yellow poplar, cottonwood and oak (usually white oak) may occur locally, and over small areas, in heavier stands.

In mixed stands, that usually average 5,000 to 6,000 board feet per acre in virgin timber, red gum makes up 15 to 50 per cent (or much more, locally) in most of the types in which it is common, and in the two mixed types in which it is most common it will average 25 to 45 per cent of the total volume over extensive areas.

An interesting association of red gum and cypress occurs on flats south of the Red River in Louisiana, particularly in St. Landry, Pointe Coupee, and West Baton Rouge Parishes. The habitat is that of normal red gum or red gum-clay land oaks types, yet cypress occurs in intimate mixture with the red gum and is equally dominant. It is probable that those sites were originally lower and formerly occupied almost entirely by cypress, which is now being gradually replaced by red gum (which started in an understory) as the sites are built up by depositions of silt and clay. There is usually a surface layer of a few

RED GUM - Liquidambar styraciflua L.

inches to two feet of clay or silty clay at the base of mature red gums, but in such places the cypress is not only mature but much older--300 or more years to the gum's 200-220. The veterans and snags are nearly all cypress, whereas the red gum is for the most part still very thrifty and vigorous.

Red gum from flats is generally more valuable than that from ridges because it is ^{Vladavost}redder and usually softer. The typical red gum from clay flats is exemplified by the famous soft-textured red timber of the St. Francis River basin, Arkansas, now almost entirely cut out. Ridge timber is usually more sappy, less red, and firmer in texture. The ridge type of growth is the more common of the two in Louisiana because, strange to say, most of the red gum on flats south of the Red River has the characteristics of ridge timber.

General appearance: Red gum is so distinctive and so widely known that no description is necessary.

Economic considerations: Red gum is exceeded in commercial importance among hardwoods only by the large group of oaks. It is possible that within its commercial range there is no species or even genus so important. The annual cut of red gum is about 25 per cent of the total cut of hardwoods (oaks make up about 35 per cent) and about 2 per cent of the total cut of all commercial species, both softwood and hardwood. In the red gum regions, red gum now makes up probably at least 50 per cent of the total cut and in many large operations the cut is 60 to 70 per cent red gum.

Red gum is used primarily for factory lumber but also to a very great extent in the manufacture of slack cooperage, rotary-cut crating and box shooks. The bulk of the low-grade lumber goes into box work. Probably no other species except white pine, shortleaf pines, cottonwood and possibly yellow poplar is used in such high proportion for shipping cases, and none but the pines exceed it in actual volume. (Cottonwood exceeds all other species in the proportion of

RED GUM - Liquidambar styraciflua L.

s own total cut used for shipping cases.) In recent years a considerable and increasing use for red gum as ties and even crossing plank has developed and with preservative treatment red gum should become a staple item in this market. In the northern part of its range it is being used for soda pulp.

Aside from the use of the lowest grades for crating, etc., as mentioned above, the uses of red gum lumber are too numerous to mention in complete detail. Every general type of factory work draws on the species to some extent. It must be stated at this point, however, that gum timber, and very often the individual gum log, yields two types of lumber that in an industrial sense are as different as though cut from two unrelated species. Their handling, marketing and utilization are separate, starting from the head rig in the sawmill, and each is graded independently through the series of standard grades. All lumber containing sufficient clear heartwood to justify an application of the appropriate grade rule to heartwood alone is designated red gum and the balance sap gum. In the following discussion "red gum" refers only to the heartwood and not to all wood of the species.

Red gum lumber is used most notably in interior finish, cabinet work and furniture, both for its own good qualities and in imitation of mahogany. It is also used in mouldings, picture frames, handles, toys, novelties, etc. The A S grade makes up the greater portion of finish and cabinet material; #1 Common grade is much used in furniture work; and mouldings, frames, handles, etc. come largely from #2 Common. Much fine paneling is now done with red gum veneer.

The outstanding use of sap gum is in automobile body work; this is not only its greatest single use, but it is the principal wood for that purpose in all but a few of the finest cars (in which ash alone is used). Sap gum lumber is used also in all the ways mentioned above for red gum, both on its own merits and in imitation of walnut. In addition, it is used for backing for more

RED GUM - Liquidambar styraciflua L.

expensive veneers, in places where a fine plain or enamel finish is wanted, as the framing for large cabinet and fixture work and as the backs and bottoms of drawers. Its use for wagon box boards is also important.

A variegated or shaded figure occurs in some heartwood due to uneven or streaked coloring, said to be caused by uneven deposit of gum against the cell walls. Lumber and veneer cut from such heartwood is called "figured red gum" and is graded on the basis of the yield of clear figured material. Such lumber and veneer are surpassed in value only by walnut.

Sap gum lumber, red gum lumber and figured red gum lumber may be either plain-sawn or quarter-sawn. They are graded and utilized separately, as are oak and sycamore, according to the method of sawing used. However, in oak and sycamore, quarter-sawing is an elaborate process intended to bring out the figure due to presence of medullary rays, while in gum (and also black gum) quartering calls only for cutting in such a way that the annual ring makes an angle of 45 degrees or more with the surface of the board. While this naturally alters the appearance, and the variation in appearance is the principal reason for quartering red and figured red logs, the sap gum is more commonly quartered. This is due primarily to the fact that quartered stock cures more readily and with less warping and degrade. Lumber for auto bodies, which is commonly 8/4, 10/4 and 12/4 stock, is nearly all quartered.

Until very recent years gum timber was cut to a large diameter limit and also selected very carefully. In fact for a long time nothing but the reddest logs would pay expenses and there was little use for sap gum except for cheap furniture and crating. Now, however, lumber operations take every tree of reasonable quality, regardless of sap, down to a 15 or 16-inch log limit. Pure

RED GUM - Liquidambar styraciflua L.

stands are thus practically clear cut. In mixed stands a satisfactory growing stock is often left, but the slack stave industry is making great inroads into this in many places because it takes the better class of timber down to a 9-inch top. The growth of the tie market for gum will utilize many stands too closely because all sound material can then be taken to an 11-inch top. Closer to the market, box shook, pulp and excelsior take even smaller material. Such close utilization may eventually offer an outlet for small trees removed in thinnings if the stands are placed under management.

In common with most other species, gum is afflicted with ordinary butt and top rots, largely the result of fire and wind damage. The most distinctive of these is a rot which hollows the butt and leaves no residue; it works only on heartwood in standing timber. Another butt rot in gum turns the heartwood to a chalky texture and light brick color. The only other common defects are a susceptibility to bird peck, presumably in unhealthy individuals, and an outstanding tendency to develop sap limbs, limited to thrifty trees exposed to an increase of light and to decadent trees dying at the top. Much lumber is degraded by these defects. The tree is damaged only ordinarily by fire and seems to have no outstanding diseases or insect enemies. It reproduces well, notably on old fields but fairly well in cut-over stands, and grows fairly rapidly--although slower than most red oaks. It responds to release slowly and unsatisfactorily except when young or below about 10 inches d.b.h. It sprouts very well.

In common with cow oak and hickory on the ridges and Nuttall oak on the flats, considerable red gum has been dying without apparent cause since 1924, and especially since 1926. The casualties are largely but not entirely large and mature or overmature trees, usually with no sign of disease or injury.

RED GUM - Liquidambar styraciflua L.

The dying trees occur most often on the wetter flats where entire groves can be found standing dead. The trees die out at the top and frequently die down one side before the other. The loss of this kind during the past seven years has been tremendous. One small tract of timber inspected in 1928 had about \$1,000 worth of stumpage on 100 acres and it was estimated that five years previously (1923) it must have been worth \$2,500; the difference was due largely to this abnormal mortality in cow oak, hickory and red gum. It is thought that where no fire injury was apparent the trees died as a result of the lowering of the water table during the 1924 drought, the full effects of which became evident only after a period of about four years.

RED GUM - Liquidambar styraciflua L.

Two species of the genus Nyssa L. occur throughout the Delta but occupy very different sites in the bottomlands and are never found together. They are: tupelo gum, Nyssa aquatica L., a swollen-buttressed tree of swamps and sloughs which is of primary commercial importance in the Delta although very common only in southern Louisiana; and black gum, Nyssa sylvatica Marshall, a tree with an ordinary, only slightly tapering, often almost cylindric trunk, and largely confined in the Delta to moist, fairly well drained, loamy ridges where it is of secondary importance and only rarely and locally common. A third species, swamp black gum, Nyssa biflora Walter, occurs on the edges of the Delta bottomlands in southeastern Louisiana, in the swamps adjacent to Lake Maurepas, but is typically a tree of the southern coastal plain piney woods flats, marshes, small swamps and branch bottoms. Since swamp black gum is so rare and local in the Delta it is not discussed below, but the characteristics in which it differs from black gum and tupelo gum are given in the following sections devoted to those two species.

TUPELO GUM - Nyssa aquatica L.

Names in use in the Delta: Tupelo, tupelo gum, cotton gum.

Distribution and habitat in the Delta: Tupelo gum ranges throughout the Delta but is confined to sites that are periodically or permanently under water. It is very common in the extensive swamps and sloughs of southern Louisiana but northward these sites are rather local and tupelo gum is correspondingly only locally common. It often grows in pure stands, and whether pure or mixed occupies deep sloughs, shallow bayous, ox-bow lakes and cut-offs, swamps and very low wet flats. In sloughs and moving water, tupelo gum usually occupies the deeper parts and cypress the margins and more shallow parts, but in deep stagnant water the two species occupy much the same depths. The soil is generally either clay or muck and the subsoil is frequently rather pervious. Many tupelo gum sites are dry or nearly dry in midsummer and early fall but accumulate three to six feet of water during an average winter.

Occurrence by forest types and common associates: Where tupelo gum occurs in pure stands, the tupelo gum type is of course recognized and constitutes the outstanding type in which the species is found. The southern cypress type is the only other one in which tupelo gum is common--or, for that matter, more than very rare. Where tupelo gum occurs at all, it is almost always either dominant and in pure stands or secondary only to cypress in mixed stands. In stands containing both cypress and tupelo gum, one or the other, and usually the cypress, is predominant.

Cypress is the chief and most constant associate of tupelo gum. Other species that are frequent associates, but of very little or no importance, include red maple, planer tree, American elm and green ash.

TUPELO GUM - Nyssa aquatica L.

Stand per acre: In mixed stands with cypress, tupelo gum generally runs up from 20 to 40 per cent of the merchantable volume, which usually runs from 6,000-8,000 to 35,000-40,000 board feet per acre. In pure stands of tupelo gum, 4,000-5,000 to 18,000-20,000 board feet per acre is common.

General appearance: Tupelo gum is a medium-sized to large tree with a rather narrow, open crown of stout branchlets and small branches. The form of the bole is unique and is rarely mistaken for that of any other species; it is greatly enlarged and swollen at the butt and tapers rapidly to a long, clear stem. The swelling is convex outward (in contrast to the concave-outward swelling and buttressing of cypress butts) and in large trees often extends to a height of ten or more feet. The bark is thin, brownish-gray, with irregular warty scaly ridges on the swollen butt and well-defined longitudinal ridges on the middle and upper portions of the stem. The leaves are large (5 to 8 inches long by 2 to 4 inches wide); thick and firm; oblong-ovate; acute or acuminate at the apex; irregularly and coarsely toothed; wavy or entire at the margin; dark green and lustrous above, pale and downy below. The fruit is an oblong, dark purple drupe about one inch long. The terminal winter buds are about one inch long and more or less globose, but the axillary buds are tiny and almost embedded in the bark.

Distinguishing characteristics: Tupelo gum differs so greatly from black gum (Nyssa sylvatica Marshall) in habitat, stem and bark habit, crown habit, leaves and winter buds that it is almost impossible to confuse the two. Water gum (Nyssa biflora Walter) also differs greatly from tupelo gum in habitat (typically piney woods swamps and branch bottoms, and in the Delta bottoms probably confined to the swamps near Lake Maurepas, southeastern Louisiana), in stem and bark habit (stem less swollen at the butt and more

TUPELO GUM - Nyssa aquatica L.

gradually tapering; thicker, slightly darker, much more deeply furrowed, roddish or grayish-brown rather than yellowish-brown bark), in leaves (half as large as those of tupelo gum, and entire), and in winter buds (all very small, about 1/8-inch long). There is no confusing resemblance between tupelo gum and other Delta hardwoods.

Economic considerations: Tupelo gum was for long scarcely used at all and then not under its own name but as "bay poplar" and largely exported. Within comparatively recent years, however, it has come into rather wide use, is now exploited wherever found and is a standard (though not a dominant) item in the domestic hardwood trade. Formerly the chief objection to it was that it was hard to dry without unreasonable warping, but it is not now considered difficult to handle. Much of the best tupelo gum is used for wagon box boards and the balance of the higher grades goes into furniture, interior trim, moulding, and novelty work, while the bulk of the #2 Common goes to box factories. Close to the great swamps of southern Louisiana where there is a tremendous supply of tupelo of poor average quality, there has been developed a specialized box industry that utilizes the mill run directly for box work. The wood is splendidly adapted to that use. It has also been found suitable for soda pulp but at the present time only a small amount is used in that way. Possibly this use will eventually supplement the box industry in southern Louisiana and furnish a reasonable basis for silvicultural practice and sustained yield in that region. Neither the rate of growth nor the value of tupelo gum makes it likely that within the near future it can be grown primarily for lumber. It is gradually becoming an important tie timber.

In cutting for lumber present utilization is remarkably complete because the tree grows to a considerable height with a very clean bole and

TUPELO GUM - Nyssa aquatica L.

Because even in small diameters small clear logs can be cut; the stems are frequently utilized far into the top. Because of the even-aged nature of the stands, tupelo gum is cut unusually close in mature timber. Occasional cutting to a ten-inch top for box material, regardless of quality, means virtual clear cutting in a mature stand.

The outstanding defect of the species is a butt rot, usually the result of fire, which hollows the stem, but as this is likely to be confined to the swollen butt it is not especially serious from the viewpoint of the lumberman because he does not use that part of the tree. It results in a loss in the case of box work, however, for the specialized box industry uses all but the worst of the soft butts. The swollen butt in itself is a disadvantageous characteristic of the tree; it is not only difficult to handle in logging and milling, but its softness and the short lengths in which it is cut make it practically worthless for standard lumber. Mature trees often die at the top without apparent reason and the crown and stem then gradually die and rot from the top downward, but as this progresses slowly and is not widespread it is not usually very serious. This condition is apparently aggravated by the lowering of the water table through drainage. With the exceptions noted, tupelo gum is thrifty, immune from serious insect and fungous damage, and reproduces well.

TUPELO GUM - Nyssa aquatica L.

BLACK GUM - Nyssa sylvatica Marshall

Names in use in the Delta: Black gum, sour gum, yellow gum.

Distribution and habitat in the Delta: Black gum is largely but not entirely confined in the Delta to moist, fairly well drained loamy ridges, principally in second or higher bottoms and only sparingly in first bottoms. It occurs throughout the Delta and is more or less frequent but only locally common. It tolerates occasional shallow overflow or occasional shallow pools resulting from winter rains, usually on hummocky sites, but probably never grows on sites frequently or usually covered with standing water. This is in marked and interesting contrast to the character of the site commonly (though by no means exclusively) occupied by black gum outside the Delta, in the eastern United States from central New England to Florida and in the Middle West--swamps; low, soggy, very poorly drained flats; margins of small ponds and pools; and the overflow bottoms of creeks and rivers. In the loessial uplands bordering the Delta, lower slopes, ravine bottoms and hammocks are the favorite sites.

Occurrence by forest types and common associates: Black gum occurs in the oak-hickory, loblolly pine-hardwood and red gum-loamy ridge oaks types mixed with a great variety of other species. The occurrence is usually in the form of single trees scattered widely through the stand and it is very rarely common, even locally. It probably does not occur in any types other than the three named.

Its most common associates are probably cow oak (especially in first bottoms), terrace hickories, American and winged elms, post oak, white oak, evergreen magnolia and loblolly pine. In the loessial uplands, yellow poplar and beech should be added to the list.

BLACK GUM - Nyssa sylvatica Marshall

General appearance: Black gum is usually only a small or medium-sized tree in the Delta bottomlands but not infrequently attains a d.b.h. of 3 to 4 feet. It has a short bole, rarely distinctly swollen or flaring at the butt end, on the contrary, usually very gradually tapering and often almost cylindrical. The crown is typically flat-topped and the lower branches are horizontal or pendulous. The rather slender branches characteristically develop a zigzag course and bear alternate short, spur-like, lateral branchlets that grow at right-angles to the branches. The bark is moderately thick (usually about $\frac{1}{2}$ to $\frac{3}{4}$ -inch), light reddish or yellowish-brown, deeply and narrowly fissured into longitudinal, much-divided but seldom interlacing block-like, scaly-surfaced flat ridges (the bark is very distinctive, usually resembling alligator hide, but it is difficult and nearly impossible to describe in such a way as to bring out clearly just what makes it distinctive). The leaves are linear-oblong to obovate, acute at the apex, 2 to 5 inches long by $\frac{1}{2}$ to 3 inches wide, entire or practically so, thick, firm, dark green and lustrous above, pale and essentially smooth below. The fruit is an ovoid, dark blue drupe, $\frac{1}{3}$ to $\frac{2}{3}$ -inch long. The winter buds are small, $\frac{1}{4}$ -inch long, reddish-brown and obtuse.

Distinguishing characteristics: Black gum differs very greatly from tupelo gum in habitat, stem and bark habit, crown habit, leaves and winter buds. It differs from water gum (Nyssa biflora Walter) in distribution and habitat (for that of water gum, see p. 189 under "distinguishing characteristics"); in stem habit (water gum has a swollen butt, black gum usually a straight butt); in leaves (water gum has narrower leaves with shorter petioles); in fruit (water gum drupes average only about one-third inch long, half the size

BLACK GUM - Nyssa sylvatica Marshall

of black gum drupes, and the stone is much more prominently ribbed); and in winter buds (water gum buds are only half the size of black gum buds and are acute instead of obtuse).

Economic considerations: Black gum has been utilized on a commercial scale for comparatively few years, due largely to the difficulty of drying it by old-fashioned, crude and careless methods. Warping causes serious losses when the wood is not properly seasoned. It is now commonly dried quite satisfactorily and its appearance and working qualities are sufficiently good for general factory work. Nevertheless it is still discriminated against in price, principally on the basis of the old prejudice, and it thus commands only a restricted market. The fact that it is available only in limited quantities and assortments at any given mill also militates against advantageous marketing.

All this is reflected in the current exploitation. Black gum is cut almost entirely to a high diameter and quality limit and most companies cut it only occasionally and leave it over considerable areas at other times. Even in the exploitation of timber for farm and other local purposes, it is one of the last species to be cut because of its slight resistance to decay, its very great toughness and its low fuel value. Many farm woods contain a few splendid black gum trees but no other merchantable material.

Despite these conditions, black gum has become a staple item in the hardwood trade and is cut in small quantities wherever and whenever conditions are favorable. The lumber is sold almost entirely to the furniture trade in the form of 4/4, 5/4 and 6/4 quartered #1 Common and Better; the low grades go to the box trade as 4/4 plain lumber. The quartering demands large logs of good quality but it facilitates drying the stock flat and adds somewhat to

BLACK GUM - Nyssa sylvatica Marshall

appearance. For local purposes black gum has long been slightly used for ox yokes, mallet heads, wooden wheels, improvised wagon tongues, etc., because of its extreme toughness and reasonable weight. Its use for railroad ties has but recently begun in the South and is rapidly expanding.

Bird peck is a frequent source of degrade. Otherwise, black gum is usually very thrifty and not affected by any serious defects or diseases.

THE ASHES - Fraxinus L.

Two ashes, white ash--Fraxinus americana L., and green ash--Fraxinus pennsylvanica lanceolata (Bork.) Sarg., are well distributed and frequently common in the Delta. Pumpkin ash, Fraxinus profunda Bush, probably occurs in the Delta but has not yet been noted by the authors. Water ash, Fraxinus caroliniana Miller, has been reported from a tupelo gum slough along the Red River, Rapides Parish, Louisiana.

White and green ashes are difficult to separate with certainty and for this reason the distributions and occurrence by forest types given in the outline and below may be somewhat in error. The following table shows distinguishing characteristics but fair warning is given that the various differences in leaves, fruit, twigs and buds (taken entirely from books by H. P. Brown, C. S. Sargent and others, and not based on the authors' observations either in the Delta or elsewhere) are by no means as clear in the field as they are in print. The variation of these organs from their typical condition is very great. The remaining points of distinction are based on field work in the Delta but are only tentative and may have to be rather drastically revised. If they are substantially correct as presented, the two species will be easy to separate.

Distinguishing Characteristics of White Ash and Green Ash

Basis for separation	White Ash (<u>F. americana</u> L.)	Green Ash (<u>F. pennsylvanica lanceolata</u> (Bork.) Sarg.)
Leaves	Leaflets obscurely cranulate-serrate, dark green above, very pale green beneath.	Leaflets sharply serrate, bright green above, light green beneath.
Fruit	Wing emarginate (notched) or pointed at the apex, not at all or only slightly decurrent on (extended along the side of) the body of the seed; seed body plump.	Wing rounded or acute at the apex, decurrent on the body of the seed to its middle; seed body long and thin.
Twigs and buds	Upper edge of leaf scar concave or notched; terminal bud rather obtuse or blunt, with 2-3 pairs of scales visible and 4 pairs in all.	Upper edge of leaf scar essentially straight; terminal bud rather acute with 2 pairs of scales visible and 3 pairs in all.
Stem habit	Trunk rarely swollen at butt, with a very gradual taper, almost always perfectly straight, comparatively tall.	Trunk usually swollen at butt, even in very small trees and to a height of 6 feet or more in large trees, rapidly tapering, often curved or crooked, comparatively short.
Bark	Ashy gray to dark sooty-gray, divided into narrow, sharp, much-interlaced, continuous ridges and more or less narrow, diamond-shaped fissures. Ridges largely triangular in cross-section.	Gray to brownish-gray but often almost covered with green mosses and lichens, divided by narrow vertical and horizontal fissures into much-interrupted, fairly broad ($\frac{1}{2}$ - $1\frac{1}{2}$ ") vertical ridges. Ridges largely rectangular or truncated-triangular in cross-section.
Distribution and habitat in the Delta	Probably confined largely to moist, well-drained loamy ridges in second bottoms where it occurs principally in small swags and drains. Not uncommon, however, in second-growth on very moist old fields in first bottoms with red gum and cottonwood. Probably also occurs on ridges in first bottoms in association with cow oak, black gum and hickories (excluding pecan and water hickory). These are usually switch-cane ridges. Locally very common.	Probably confined largely to flats in both first and second bottoms, where it is often very common, especially on cut-over flats. Rare on ridges except clay ridges in first bottoms. Of best quality and by far most common on the better clay sites in first bottoms. Occasionally found in deep sloughs and swamps.

Occurrence by forest types	<u>Oak-hickory</u>	<u>Oak-elm-ash</u>
	Red gum-loamy ridge oaks Loblolly pine-hardwood Willow oak-cherrybark oak-cow oak Southern cypress hardwood (mainly in northern Arkansas) Red gum Oak-elm-ash (on terraces)	<u>Red gum-clay land oaks</u> <u>Overcup oak-water hickory</u> Hackberry-elm Red gum Willow oak Willow oak-cherrybark oak-cow oak Southern cypress-hardwood
Texture of wood	Firm to tough, hard, of uniform texture throughout the stem, seldom showing the variegated brown coloring at the heart known as "calico".	Firm to brash, seldom tough but usually firm except in the swollen butt where it is almost always brash and sometimes actually punky. The heart is frequently "calicoped".

Nothing further will be said about the dendrology, distribution or associates of white and green ashes because of the uncertain accuracy of the information. It is thought, however, that the material given under stem habit, bark, distribution and habitat and occurrence by forest types in the above table points out very real and generally true distinctions that are sufficiently accurate for practical use.

Names in use in the Delta: White ash is variously known as ash, white ash and cane ash. Green ash is called ash, yellow ash, swamp ash, slough ash and pumpkin ash.

Economic considerations: Probably only oak, red gum, birch, maple and yellow poplar exceed ash in economic importance amongst the hardwoods. Ash is one of the most indispensable hardwoods for several domestic and foreign uses, and consequently its importance is of special significance. Most species fail in popularity and cease to rise in stumpage value after they attain a certain degree of popularity because of the adoption by the trade of cheaper and more available substitutions. This has been the case with "red" cypress in the past

THE ASHES - Fraxinus L.

five years, but to date has not been the case with ash despite a pronounced scarcity. Ash is of course still available in reasonable quantities in all standard grades and thicknesses but it comes increasingly from the green ash of the swamps, which causes much difficulty over "texture" and the principal consumers and exporters have constantly to be on the alert for satisfactory supplies. However, ash still has the highest stumpage value of any of our native hardwoods with the exception of walnut and black cherry.

The most important domestic uses of ash are for long handles and special turnery, light vehicles, the best automobile bodies, wagon tongues, cars, athletic goods, and all similar work requiring fine working qualities and an unusual combination of strength, resilience and lightness. Needless to say, such work calls for tough or at least firm stock. Firm to brash stock is much used for interior finish, cabinet work (especially framing of store fixtures and refrigerators), medium and cheap furniture, small handles, toys and novelties, and even flooring. In these latter uses it competes with oak, but in the manufacture of refrigerators firm to brash ash seems to be a fixed favorite. In foreign countries the uses are much the same as here and the foreign markets are strong competitors for the supply of tough material. Large quantities are exported in the log for the foreign manufacturers to use in direct manufacture. Locally ash is used somewhat in making handles and in wagon repair work. The outstanding local use, however, is for fuel, for which purpose, because of its splitting qualities and its ability to burn green as do longleaf pine and hickory, it is in great demand and young stands are often ruined by cuttings made entirely for firewood.

Ash is the premier slack cooperage wood and a secondary tight cooperage wood. Cutting for this purpose is dangerously severe. Both ashes are "white ash" as lumber and staves.

Because of its value and scarcity and because it cuts a relatively high

average grade for any given size and quality of timber, ash is one of the most closely utilized of all hardwood species. The felled trees are not only closely utilized, which is of course desirable, but trees are cut to such a small diameter limit that entire stands are often cut clear. A 10-inch top diameter limit is common. Cottonwood is probably the only species in the Delta that compares favorably with ash in degree of close utilization in the woods. About the only type of exploitation that leads to waste of felled material is the cutting of bolts and billets for baseball bats and special handle blanks such as golf sticks. This leads to great waste because of the rejection of much material on the basis of texture, and occasionally a tree is cut and left entirely unused as was once the case with white oak in the riving of staves. Log exporters commonly abandon much material in cutting green ash in swamps because they invariably cut for firm-and-better texture; few butts in this type of timber will qualify and the unsuitable butts are cut off and left in the woods. Exporters commonly work higher into the tops than other operators, however, and take shorter lengths. Their diameter limit is about the same.

Ash reproduces well and where it is not too accessible to fuel cutters it has an assured future. Where it is accessible, farmers practically exterminate it by cutting for fuel. Over some large areas in farming sections where a log of saw timber has never been cut on a commercial basis, it has practically disappeared, along with white oak and red mulberry. The farms and villages are the greatest obstacles to the future of ash, especially white ash, which is usually the more accessible. Ash commands a ready local market at premium prices as firewood and this use damages the forest to a much greater extent than all commercial uses and probably to no less extent than fires. Green ash undoubtedly has the more promising future but a certain amount of

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white ash will undoubtedly survive on the better sites even though they are more accessible and more subject to agricultural development, especially as ash is almost certain to be a favored species in silvicultural management. Its high value, fair rate of growth and good reproductive properties are strong points in its favor.

Ash has no outstanding defects or peculiarities. A peculiar bright yellow dot that hollows out the central core for a few feet at the base of the punky butt of green ash, but causes little monetary loss, is the principal fungous damage. No insect pests have been noted. Green ash is inclined to grow crooked stems if the stand is dense and many of the trees partly suppressed. Fire is especially injurious to ash because the bark, although thick, is easily killed by light scorching, letting in another type of butt rot. Ash is also the most subject to crown fires of any of the hardwoods. More ash than any other species is killed outright by fire and it is about the only hardwood to be entirely consumed standing, as shown in 1924 when the bottomlands were unusually dry and forest fires unusually numerous and severe.

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RECOMMENDED REFERENCES ON DENDROLOGY

Publications Containing Good Descriptions and Illustrations of the Species of Trees Found in the Delta Region

(This is by no means complete but is merely a brief list of dendrology texts and bulletins that have proved most accurate and useful in dealing with the southern bottomland hardwoods. With the exception of the one by Miss Dormon, none--and none could be found--apply directly or especially to any of the Delta states, but for many of the more common species found in the Delta the botanical descriptions and illustrations are as applicable as if made especially for that region.)

- (1) Brown, H. P. Trees of New York State, native and naturalized. Tech. Pub. 15, N.Y. State College of Forestry, Syracuse, N.Y., 1921. (Excellent and complete drawings and technical descriptions.)
- (2) Dormon, C. Forest trees of Louisiana and how to know them. Louisiana Department of Conservation, undated. (Very good non-technical descriptions and drawings.)
- (3) Gates, F. C. Handbook of Kansas trees. Report of Kansas State Board of Agriculture, Vol. 47, No. 186-A, Part 2, pp. 148-367. Topeka, Kansas, 1928. (Very good technical descriptions and drawings.)
- (4) Harlow, W. M. The dendrology of the more important trees of the United States. N.Y. State College of Forestry, mimeographed, 1930. (Information largely taken from Hough & Sargent, with little or no original data on bottomland species but good outline drawings of leaves and fruits.)
- (5) Hough, R. B. Handbook of the trees of the northern states and Canada. Third edition, 1924. (Very good photographs of leaves and fruits.)
- (6) Illick, J. S. Pennsylvania Trees. Pennsylvania Department of Forestry, Bull. 11, 4th edition, 1923. (Very good technical descriptions, drawings and bark habit photographs.)
- (7) Miller, R. B., and Tehon, L. R. The native and naturalized trees of Illinois. Illinois Department of Registration and Education, Division of Natural History Survey, Vol. 18, Article 1, Bulletin. Urbana, Illinois, 1929. (Very good photographs of leaves and fruits.)

(8) Sargent, C. S. Manual of the trees of North America. 1905;
second edition, corrected, 1926.

(9) Appendix, pp. 204-207. Complete technical description of Nuttall
oak, Quercus nuttallii Palmer, which is not in-
cluded in any of the above publications.

APPENDIX

The following detailed technical description of Quercus nuttallii Palmer is given here because the species is not described in any book on dendrology available at the present time. The species was first described under its present scientific name by Mr. E. J. Palmer of the Arnold Arboretum, Jamaica Plain, Massachusetts, in the Journal of the Arnold Arboretum, Vol. 8, No. 1, 1927. The following description is not taken from Mr. Palmer's writings but is original. It is more complete for the various organs and parts than the section on Nuttall oak, pp. 115-119, but for the distribution, habitat, associated species and economic aspects, see those pages.

NUTTALL OAK - Quercus nuttallii Palmer

Size and Habit

A medium to large-sized tree sometimes 3 to 4 feet in diameter and 90 to 120 feet high, with a symmetrical, pyramidal crown when young, a broad, rather open crown when mature, and a tall trunk usually clear of branches for only a short length. The trunk is usually strongly buttressed on large trees. The lower branches of the crown are horizontal or pendulous, and the upper branches are horizontal or ascending.

Leaves

Dark green above, paler but still very green below, thin, firm, glabrous except in the axils of the larger veins, which have whitish to yellowish tufts of hair or scurf, 4 to 8 inches long by 2 to 5 inches wide; on small trees and the lower branches of large trees, the blade usually distinctly widest above the middle and tapering to a cuneate base; the upper leaves of mature trees smaller, of almost uniform width, essentially truncate at the base and cut by deep sinuses, rounded at the bottom, into 5 to 7 (rarely 9) lobes, usually the latter number. The lowermost pairs of lobes are generally the narrowest and most acuminate and are often entire with the apex bristle-tipped, otherwise each lobe ends in 2 or 3 small bristle-tipped teeth. In the lower leaves lobes at or just above the middle of the blade are typically rather broad, with almost straight, parallel sides, and concave-truncate at the apex, which has 2 to 8 (usually 2-5) bristle-tips; otherwise these lobes are 2, or more commonly 3, toothed, each tooth having a bristle-tip. The terminal lobe is either entire, acuminate and bristle-tipped, or 3-toothed with the middle tooth much longer than the others and all bristle-tipped. On upper leaves

NUTTALL OAK - Quercus nuttallii Palmer

and small leaves, all the lobes may be entire or nearly so. There is great variation in the size and shape of the leaves. The total number of bristle-tips per leaf is usually between 10 and 25. Petioles slender, glabrous, $\frac{3}{4}$ to $1\frac{1}{2}$ inch long; midrib rather slender. The leaves fall very slowly through the late fall and early winter, turning first pale green and finally an inconspicuous yellow-brown or dull light brown (rarely reddish) before falling.

Fruit

Sessile or short-stalked; nut oblong-ovoid, rounded and usually distinctly narrowed at the apex, at first scurfy, later lustrous, light to dark reddish-brown, almost always striate, $\frac{1}{2}$ to 1 inch wide by $\frac{3}{4}$ to $1\frac{1}{4}$ inch long, in a thick-based deep cup that encloses one-fourth to one-half of the nut. Both the shape and size of the nut and the shape and depth of the cup are extremely variable, often even on a single tree.

Winter Buds

Borne on glabrous, light grayish-brown to reddish-brown branchlets. Usually just under $\frac{1}{4}$ -inch long, plump, ovoid, acute to acuminate at the apex, inconspicuously 5-angled, light medium brown or grayish-brown, glabrous or very slightly pubescent.

Bark

Light grayish-brown to very dark brownish-black, usually light on small, young trees and dark on large, old trees. Exceedingly firm, hard and close, $\frac{1}{2}$ to 1 inch thick. Broken into rather broad, very firm and close, low, flat, longitudinal ridges--which have a surface of hard, much-divided, very closely-appressed, rather rough and often pale, gray scales--by shallow, usually narrow, yellowish to pinkish-brown fissures. Freshly-chipped ridges are pale

brown to cherry red. Small burls and irregular excrescences are often abundant.

There are never prominent deep furrows or thick ridges, except occasionally on the lowermost portion of the butt of very old or large trees. The shallow furrows are generally much lighter in color than the low ridges but on large trees the ridges may be one inch or more wide and covered with very pale gray scales that are lighter, viewed from a short distance, than the furrows.

On very small trees or on the limbs of large trees, the bark is generally pale grayish-brown, very firm and close, often with prominent yellowish furrows, and commonly warty or with irregular excrescences.

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